Concrete

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Highway Department Methods of Curing Concrete Pavements

Ponding, Wet Earth, Wet Straw, Calcium Chloride, Asphaltic Seal Coats and Sodium Silicate Among Established Methods—Wet Burlap First Day—The Curing Period

This article, the fifth in a series dealing with state highway department construction practices, gives a survey of established methods of curing concrete pavements.

The next article will discuss the question of longitudinal and transverse joints.—The Editors.

MANY state highway departments continue to favor the older curing methods such as ponding, wet earth, and wet straw, though with but few exceptions they permit the use of commercial curing agents developed with special reference to use on concrete pavements.

Surface Application of Calcium Chloride

As might be expected, states with a large construction program will have, during the course of the year, experience with various kinds of curing methods. A notable exception is seen in the state of Illinois. In answer to a letter addressed by CONCRETE to state highway departments, C. M. Hathaway, Engineer of Construction, Illinois Division of Highways, writes: "Calcium chloride is used as a curing agent on about 95 per cent of the paving work in this state."

Missouri is another state in which calcium chloride is used extensively. "Wet burlap," writes T. H. Cutler, Chief Engineer of the Missouri State Highway Department, "is followed with calcium chloride surface application, some pondings, and straw at lower temperatures."

Highway engineers from a number of other states mention the surface application of calcium chloride as one of the curing methods permitted.

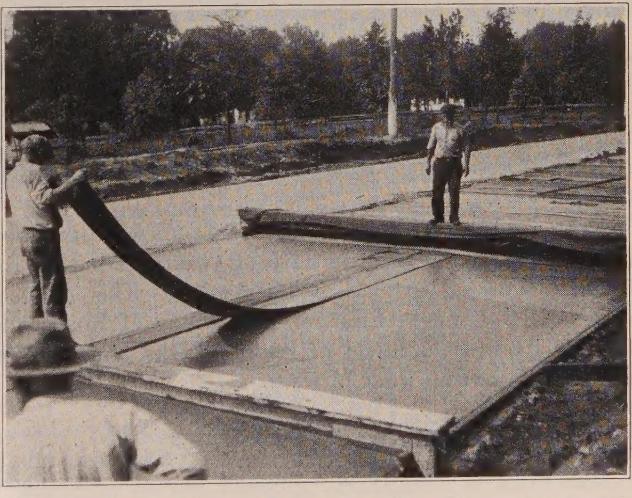
Calcium Chloride Used Integrally

Several engineers have reported satisfactory experience with calcium chloride used integrally. An interesting case is that from Louisiana, where, in the words of E. H. Kivett, Physical Testing Engineer, Louisiana Highway Commission, "We are using wet earth and ponding at all times, and calcium chloride is used integrally during the calendar months of December, January, February and March."

W. E. Hawkins, Construction Engineer, North Carolina State Highway Commission, likewise writes that "Our concrete pavements are cured by ponding, by wet earth, and calcium chloride used as an admixture."

Asphaltic Seal Coats

In New Jersey, R. B. Gage, Chemical Engineer, New Jersey State Highway Commission, states that the bituminous coating method and hay or straw are the two curing agents employed.



Wet burlap is commonly employed as the curing medium for the first 24 hours

C. H. Purcell, State Highway Engineer, California Department of Public Works, writes that impervious membranes are used in special cases, while W. W. Zass, Engineer of Construction, Arkansas State Highway Department, mentioned an "asphaltic seal coat" as one of four curing methods employed, the other three being wetted earth, ponding, and sodium silicate. A number of other states indicate this as one of the curing methods sanctioned.

Sodium Silicate

Mention has already been made of the use of sodium silicate as a curing agent in Arkansas. From Virginia, C. S. Mullen, Chief Engineer of the State Department of Highways, writes that sodium silicate is one of the three curing agents commonly used, the other two being wet earth and calcium chloride surface application. In Maine, according to Lucius D. Barrows, Chief Engineer, State Highway Commission, sodium silicate, calcium chloride, wet burlap and wet earth covering are the four curing agents commonly employed, though he states that wet burlap covering is the method most generally used.

Curing under straw in Connecticut

Other states mention the use of sodium silicate to a limited extent.

Wet Burlap and Ponding

It seems to be quite the general practice to cover the freshly laid concrete with wet burlap for the first 24 hours, regardless of what curing method may be employed after that period.

Nebraska, however, has adopted a somewhat different method, one which involves covering with wet burlap for 3 days, followed by 3 days of ponding. This method, writes A. T. Lobdell, Chief of the Bureau of Roads and Bridges, State Department of Public Works, was used on all concrete paving work in 1930.

Wet Straw Exclusively in Two States

Highway engineers from a number of states mentioned wet straw covering as one of the curing methods often employed.

In New Hampshire, however, Frederic E. Everett, Highway Commissioner and State Engineer, mentions wet straw as the only curing method employed.

"In Indiana," writes William J. Titus, Chief Engineer, State Highway Commission, "practically all of the curing of concrete pavements in state highway work is by the straw and water method. Our specifications permit ponding, and occasionally we have a contractor who will cure a portion of his contract by ponding."

Where Ponding Is Impractical

While the ponding method has been employed successfully for many years, several highway engineers point out conditions under which this method is impractical. For instance, in mountainous and rolling topography, where the maximum grades are encountered along much of the route, ponding is not feasible. The same is true in localities where water is not readily available in large quantities.

Wet Earth

Wet earth as a curing medium is mentioned more frequently by the highway engineers who responded to the letter addressed to them by CONCRETE, and in two states—Oklahoma and Oregon—this method was used exclusively on all 1930 contracts. In the words of S. H. Probert, Office Engineer, Oregon State Highway Commission, "All of our concrete pavements are cured under a wet earth cover. Other methods are permissible under our specifications, but no others have been used."

While curing with wet earth admittedly involves the handling and rehandling of much material, and daily attention during the curing period, several engineers mention "confidence in the results" as their reason for favoring this method.

The Curing Period

In only a few instances has the length of the curing period been mentioned. In Nebraska, as previously indicated, the curing period is 6 days, namely, 3 days under wet burlap and 3 days of ponding.

The specified curing period under the ponding method or any other method involving the use of water is 10 days in California. In Virginia and Texas the curing period for wet earth is 14 days.

New Officers Are Elected by Testing Society

American Society for Testing Materials Chooses New Heads—Cement Testing Engineer to Executive Committee

New officers of the American Society for Testing Materials were elected at the recent annual convention in Chicago.

The new president is Frank O. Clements, technical director of the research laboratories of the General Motors Corporation, Detroit, Mich.

The vice-president is Samuel T. Wagner, consulting engineer for the Reading Company, Philadelphia, Pa.

New members of the executive committee are Arthur W. Carpenter, manager of the testing laboratories of the B. F. Goodrich Co., Akron, O.; Kenneth B. Cook, technical manager of Manville Jenckes Co., Pawtucket, R. I.; J. B. Johnson, chief of the material branch, material division, U. S. Army Air Corps, Wright Field, Dayton, O.; George C. D. Lenth, consulting engineer for the Clay Products Association, Chicago, Ill.; and O. L. Moore, engineer of tests, Universal Atlas Cement Co., Chicago, Ill.

Quality of Concrete Held Uniform in Structures of Many Types

Three-Year Construction Program Completes Welding of Residential, Business and Industrial Sections of Dallas —Move River Two Miles—Some Placing Methods Are Illustrated

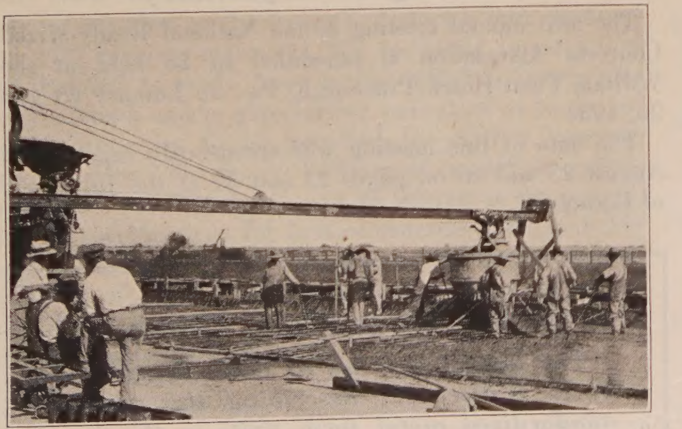
By **JEAN H. KNOX**
Consulting Engineer, Dallas, Texas

BY an ingenious grouping of some twenty-one miles of earthen levees, the bodily moving of a river some 2½ miles, and an intricate interlacing of reinforced concrete construction, Dallas, Texas, has practically completed a program of welding together her largest residential section with the business part of the city. In addition to accomplishing this objective, the Trinity River Reclamation program has made available some 10,000 acres of highly valuable industrial, aviation, and recreational property.

The concrete structures, which form an important part in the industrial and economic plan of the reclamation program, may only be generally described in this article, due to the fact that they are both numerous and detailed.

Seven major viaducts were planned and executed. Two of four underpasses will soon be completed, three with a traffic width of 40 ft., one with six 10-ft. lines for traffic.

Ten pumping plants having a combined capacity of 276,000 gal. per min. were constructed for the relief of storm waters behind the ten miles of levees during flood stages of the Trinity River. Concrete pavement to the amount of 118,600 sq. yd. will be completed during 1931. The total yardage of concrete exceeds 147,600 cu. yd. for all projects; precast concrete piles to the amount of 149,675 lin. ft. were driven. Reinforcing bars and structural steel comprise 12,500 tons.



Placing concrete with a paving boom, on Commerce Street viaduct

Modern Methods of Concrete Control

Modern methods of concrete control governed in all phases of the work. Due to excellent concrete aggregates, the uniformly high grade of cement available in this section, and the intelligent co-ordination between the engineers and contractors, the three years of the construction period saw remarkable uniformity in the quality and strength of the various classes of concrete.

Crane places one-yard batches of concrete from the mixer to the deck of the Dallas Railway & Terminal Co. viaduct

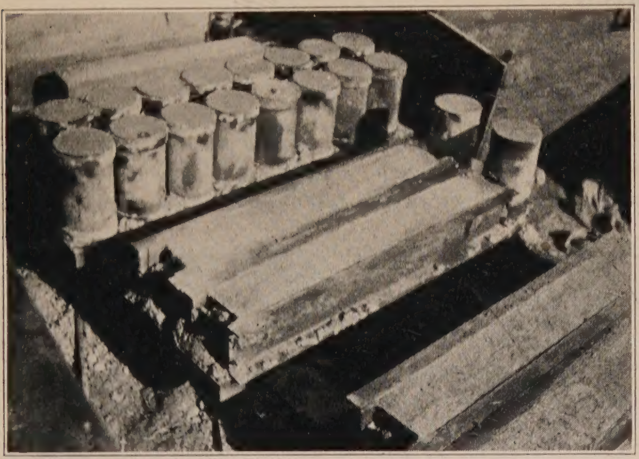
Comprehensive analyses of materials and tests based on mortar-voids and maximum density were made for all probable changes in grading and physical characteristics of the aggregates.

Minimum cement content, maximum net water allowable, together with minimum compressive and tensile strength of concrete, were requirements in all specifications. The characteristics of the two cements used were carefully considered as to fineness, normal consistency and uniformity of quality. All quantities of aggregate were determined by absolute volumes, and weight proportioning for the fine and coarse aggregates was used for all classes of work.

Compensation in weight of aggregate batches and allowable water was made by moisture tests of aggregates hourly or more often where necessary.

Central proportioning plants were used in all cases, except where central mixing plants were used on one bridge project and one paving project.

From six 6 by 12-in. cylinders and two 6 by 6 by 42-in. beams up to 24 cylinders and 8 beams were made on each day's run on all the major projects. Part of the test specimens were cured in the field and part in the moist room at 70 deg. F. Breaks were made at 4, 7 and 28 days, with many specimens kept for 90 days and others for one and three years.



Set of test specimens for each run of 50 to 200 cu. yd. of concrete includes eighteen standard 6 by 12-in. cylinders and six standard 6 by 6 by 42-in. beams

Heat Water in Cold Weather

Care was taken not to place concrete at temperatures lower than 42 deg. F. for the fresh concrete, although temperatures of some of the aggregates might have been lower in cold periods. Likewise, temperatures of fresh concrete above 90 deg. F. were avoided. Where mixing water was heated it was not heated above 180 deg. F., and cement was not used if its temperature was above 120 deg. F.

Removal of centering and forms on structural concrete, and time of curing and opening to traffic for pavement, were dependent on results of cylinder and beam tests. Occasions were rare where forms and centering were held longer than 7 days, while concrete piles driven between the ages of 7 and 21 days showed results equal to older piles.

Minimum Cement Content

Including precast pipe, structures and pavements, Class B concrete called for 5 sacks of cement per cu. yd. of concrete. Class A required 6 sacks. Sidewalks, balustrades and concrete piles were made of Class D concrete, containing 7 sacks to the cu. yd. Net water ranged from 5¼ to 6 gallons per sack of cement, according to the consistency required. This did not include allowable water for variation in normal consistency of cement, nor losses by absorption and evaporation.

Since it is practicable to obtain satisfactory strengths of concrete, it was considered paramount to strive for workability, density, and uniformity, and the result is that almost the entire program of construction shows a remarkably uniform concrete of higher strength than specified, with a variation of approximately one per cent in the cement used.

Since proportions of fine and coarse aggregates were determined by combined density, and since it was found practicable to shift temporarily that section of aggregate particles from ¼ to ⅜ size in larger part over to the fine aggregate side, to lessen segregation in stocking coarse aggregate, proportions ranged from approximately 43 to 53 per cent fine aggregate, and 57 to 47 per cent coarse aggregate.

Acknowledgments

Myers, Noyes & Forrest are engineers for the levee district, and the Morgan Engineering Company are consultants. The engineering department of the Texas & Pacific Ry. designed and supervised their work, and the engineering department of the Rock Island Ry. did the same for their work. The engineering department of the city of Dallas had charge of storm sewers and water mains within the reclamation district.

The power, light, and gas utilities conducted major improvements in the area. Stone & Webster served as engineers, with the engineering department of the Dallas Railway & Terminal Company acting as supervising engineers for the North Texas Traction Company viaduct. Rollins & Clinger were district engineers for the county of Dallas, and F. D. Hughes was consulting and designing bridge engineer for the county and city of Dallas.

The writer was associated with Dallas County and the Dallas Railway and Terminal Company as consultant on concrete and as engineer of construction. The entire project represents an expenditure of about $21,000,000.

Ready-Mixed Concrete Association Meeting Next January

The next annual meeting of the National Ready-Mixed Concrete Association is scheduled to be held at the William Penn Hotel, Pittsburgh, Pa., on January 25 and 26, 1932.

The date of this meeting was erroneously reported as August 25 and 26 on pages 22 and 39 of the July issue of CONCRETE.

More About Metal Forms

The last of a series of three articles by B. E. Wiltscheck, describing the use of standardized metal form units in the construction of foundation walls and reinforced concrete floors on the Morgandale High School contract in Milwaukee, appears in this issue.

Other articles, containing similarly detailed descriptions of the use of metal forms of other types, will appear in the coming issues of "Concrete."

Stability of Concrete Masonry Walls Reported to A. S. T. M.

Tests of Large Wall Panels and Wallettes of Concrete Masonry at University of Illinois Prove Value of This Type of Construction

By F. E. RICHART,[1] P. M. WOODWORTH[2] and R. B. B. MOORMAN[3]

The tests here described constitute the first important accomplishment in the research program of the Concrete Masonry Association since the reorganization of that body in 1930.

This notable undertaking, made under a co-operative arrangement with the University of Illinois, is the most important event in the concrete masonry unit industry since the series of fire and water tests made by the Underwriters' Laboratories.

The results of these tests will go far toward maintaining a front rank position in the building industry for concrete masonry building units.—The Editors.

IN the development of standard specifications for masonry building units it is necessary to know what relation exists between the strength properties of building unit and mortar and the strength and stability of walls in which they are used. Except for tests of pilasters and of walls made recently in connection with fire tests, there is little information on the strength of story-height construction with concrete masonry. The following investigation was designed to study those factors which influence masonry strength and to give further indication as to the essential properties to be specified for hollow concrete building units. The matter becomes of immediate importance to the A.S.T.M. because of its interest in the preparation of specifications for hollow concrete units, and this progress report of the wall investigation is made now with the object of placing before the Society the principal results of the investigation, obtained from tests carried on since the beginning of the year.

Outline of Tests

The tests were planned primarily to furnish information on the behavior under load of wall panels of sufficient size to represent building construction; with this in view a panel 6 ft. long and about 9 ft. 6 in. high was chosen. Small panels, or wallettes, 32 in. long and 48 in. high (having about the same ratio of width to height as the large walls) were also used to determine whether or not they could be established as representative test specimens for masonry walls, and, if so, to determine the correction factor to be used with wallette strengths to make them directly comparable with the values from the large panels. The main group of test panels was planned for a compression test with a uniformly applied axial load. Four lots of walls were also tested to furnish information on the strength of walls eccentrically loaded. To secure data on the flexural strength of the various types of walls, a large panel of each lot was subjected to a bending test.

Schedule of Walls Tested

The general schedule of walls tested is listed below. Generally, two small walls and two or three large ones (one tested in bending) are represented by each item:

1. Type of Aggregate (Lots 1 to 8)	Units made of cinders, haydite, sand-gravel, limestone and crushed air-cooled slag. First 3 used with 2 strengths of unit and 2 forms of mortar bed.
2. Strength of Units (Lots 1 to 3, 6 to 8, 10 to 11)	Units of haydite, cinders and sand-gravel concrete made in strengths of 550 to 1550 lb. per sq. in.
3. Type of Mortar Lots 1, 3, 8 to 11)	Two mortars, 1:1:4½, cement, lime and sand, dry rodded, and 1:3 cement mortar with addition of 10 per cent of lime by weight of cement.
4. Type of Mortar Joint (Lots 1 to 3)	Walls of cinder, haydite and sand-gravel concrete units laid up with full mortar beds and with mortar bed on face shells only.
5. Design of Unit (Lots 8, 12, 13)	*Three types of unit in 8-in. wall* 8 x 8 x 16-in., with 3 oval cores 5 x 8 x 12-in., tile, 2 square cores 3½ x 8 x 12-in., tile, 2 square cores
6. Wall Thickness (Lots 2, 3, 14, 15)	Two thicknesses of wall made with 8 x 8 x 16-in. and 8 x 12 x 16-in. units, 3 oval cores, with haydite and sand-gravel units.
7. Composite Walls (Lots 16, 17)	Walls with 4-in. of face brick and 8 x 8 x 16-in. backup block of haydite and cinder concrete. Header course every sixth brick course.
8. Eccentric Loading (Lots 18 to 21)	Walls of haydite, cinder and sand-gravel block and sand-gravel tile units. Loaded with eccentricity one-sixth of wall thickness.

Manufacture of Units

The units with three oval cores (8 by 8 by 16-in., and 8 by 12 by 16-in.) were made on contract at a local plant using an Anchor hopper feed, mechanical tamper and

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Condensed from paper presented before annual meeting of American Society for Testing Materials, Chicago, Ill., June 26, 1931.

stripper machine. The concrete was mixed in a paddle mixer in batches producing 15 to 22 blocks. The materials for each batch were measured separately by means of a Johnson weighing batcher and combined at the mixer. The proportions of fine to coarse aggregates in general followed the plant practice and were designed to produce units with a fairly rough texture. The fineness modulus of the combined aggregates was 4.0 to 4.25 except for cinders, in which the coarse grading produced a value of 4.70 in the mix chosen. Each batch using sand-gravel, limestone and slag was mixed 1 minute dry and 5 minutes after water was added. The haydite and cinder aggregates were mixed 2 minutes wet with about half of the mixing water added, and 3 minutes more after the cement and the balance of the water were added. The proper consistency was determined by the plant operator, based upon the appearance of the units. Each block was tamped from 10 to 12 times with each of the tamper feet.

The units were cured for 48 hours in a steam curing room, heated by steam coils along one side of the room and with moisture supplied from open petcocks on the lower steam coil. The temperature of the curing room was held at about 100 deg. F. at night and at 80 deg. F. in the daytime. Upon removal from the curing room, the units were stock-piled under cover until 21 days old, when they were delivered to the laboratory.

Building the Test Walls

The walls were built by a union mason and helper, hired by the hour. They were instructed to follow their usual style of workmanship, except where different types of mortar and bedding were required by the schedule. Vertical joints were not filled, beyond buttering the edge of the unit as laid and final pointing of joints. In the brick courses of the composite walls, the mortar bed was spread, not furrowed. In these walls, in which backup blocks of haydite or cinder concrete were used, each header brick was placed over a web of the concrete unit.

Testing Procedure

The walls of lots 1 to 17, inclusive, were tested in axial compression. The large walls were tested 32 days after erection, in either a Southwark-Emery machine of 3,000,000-lb. capacity or in a Riehle machine of 600,000-lb. capacity, with a test speed of about 0.05 in. per minute. Due to care in the preparation of pallets and laying up of walls, the alignment of specimens in the machine was very good. Load was applied through a spherical bearing block and two 24-in. I-beams to the heavy steel bearing plate used to cap the wall. The stiffness of the I-beams was sufficient to distribute the load uniformly over the length of the wall.

The small walls were tested in the same manner as the large ones except that vertical deformations were measured by a 40-in. compressometer at the middle of each side of the wall.

Flexure Test

A flexure test was made on one of the large walls of each lot. These walls, which failed by cracking along a horizontal joint near mid-height, were later tested in compression, and developed as good compressive strengths as the uncracked walls.

Eccentric compressive loads were applied to the walls of lots 18 to 21. The procedure differed from the ordinary compression test only in that load was applied at the top of the wall through a ¾-in. square cold-rolled steel rod resting on the top bearing plate and one-sixth of the wall thickness from the central plane of the wall.

Conclusions

The principal conclusions from the investigation may be summarized as follows:

1. The compressive strengths of the large walls of all types varied from 335 to 850 lb. per sq. in.
2. The strength of walls was evidently dependent mainly upon the strength of the building units and was little effected by variations in strength of mortar.
3. The ratio of the compressive strength of large walls to the 60-day compressive strength of units used was found to be quite well defined. The average value of the ratio is 0.53.
4. The ratio between the compressive strength of large walls and of wallettes was also fairly constant, with an average value of 0.91. This result suggests the feasibility of using wallettes as representative of wall construction in further tests.
5. Tests of walls made of 8-in. units with 3 oval cores showed that the compressive strength with face-shell mortar beds was 80 per cent of that produced by the use of full mortar beds.
6. Little definite effect could be established as due to variations in type of aggregate, type of mortar or thickness of walls. Some differences found with three types of unit could be explained by the arrangement of cross-webs of the units.
7. Composite walls of face brick and concrete building units showed good inter-action of the two types of unit, and quite satisfactory strengths, even though the walls developed a marked deformation and deflection before failure.
8. The flexural strength of the walls was evidently a function of the adhesion of the mortar to the bearing surface of the unit, since all transverse failures occurred at the junction of the two materials. Values of modulus of rupture for the walls vary from 18 to 50 lb. per sq. in.
9. The walls in which the eccentric compressive load was applied at the edge of the middle third of the wall thickness showed strengths averaging 76 per cent as great as were obtained with axial loading.

Acknowledgments

The investigation here described was carried on at the Materials Testing Laboratory, University of Illinois, in co-operation with the Portland Cement Association and the Concrete Masonry Association. The work was done as a regular project of the Engineering Experiment Station under the administrative direction of Dean M. S. Ketchum, director of the Station, and Prof. M. L. Enger, head of the Department of Theoretical and Applied Mechanics. The two associations were represented by an advisory committee consisting of W. D. M. Allan, chairman, Nolan Browne, D. R. Collins and Benjamin Wilk. Members of this committee co-operated in the outlining of the investigation and assisted in providing facilities for the work.

Twenty Ready-Mixed Concrete Plants Surveyed by Investigator

Much Variation in Equipment and Plant Arrangement—Plants Should Be Adaptable to Change—Outside Inspection and Certification on Increase

By E. F. McCREADY
Allentown Testing Laboratory, Allentown, Pa.

It should be said that while the writer has made every effort to make the accompanying tabulation accurate as to each plant, it should be taken more as a general indication of the trend of the industry. It was not always possible to get complete information on each plant, due to the absence of some official; so possibly—as usual—a few plants have been under- or over-estimated. For such errors we beg their pardon; but on the whole, this can be taken as a fair representation of the ready-mixed concrete industry in the East and of its need for greater uniformity in operation.—The Author.

THE most surprising thing about a study of twenty ready-mixed concrete plants is the great differences between them. Looking over a number of centrally-mixed and transit-mixed plants is not like examining the same number of silk mills or road-building projects. These concrete plants are still too new to have a great deal in common.

There are good plants and bad ones, cheap ones and very expensive ones, profitable ones and unprofitable ones; and the puzzling thing is that the rules for a successful plant are not very obvious. More often than not, the chief cause for success seems to be the man or group of men back of them.

Some Conclusions from the Survey

A very few generalities may be made, however. From the tabulation it can be seen that it is about an equal break between the centrally-mixed and the transit-mixed types of plants. The coming plant seems to be a combination of the two—the centrally-mixed system for deliveries within three or four miles, and the transit system for deliveries at a distance or where delay is likely. In one large city recently a public inspector waved back six trucks from a centrally-mixed plant. The trucks had been churning for a half hour alongside a sewer while the work was held up. Transit-mixed trucks probably would have saved the concrete people money on that job by not starting to mix until the truck ahead was ready to dump. Plants of this dual type have a by-pass chute from the weighing batcher direct to the truck. There are several makes of truck bodies now built that work well for either mixing method. The present drawback to a greater use of the dual method is the idea that some ready-mixed concrete men have that a transit mixer is more expensive to operate, although the writer has been unable to check up on the claim.

Uses Portable Batching Outfit

A notable example of the other side of the question is the transit mixer operator who bids on jobs throughout New England and says he makes out very well.

"I have a portable batcher," he told the writer, "very similar to the regular truck-batcher, which can be taken apart and shipped. Then I simply have my men drive the trucks a hundred miles or so to the new set-up, and we are ready for business.

"This works especially well," he continued, "on jobs away from the cities. It does away with mixers, buggies, wheelbarrows and much other paraphernalia of a contractor."

Plants Must Be Adaptable to Change

Another generality that can be made is that the best plants are those that are easily adaptable to change. All of the older ones were built that way and have undergone many changes, experiments and improvements. There is every reason to believe that improvements will continue to be made in the plan of plants, so that a plant which can easily be added to is the best paying one. The Reading Ready-Mixed Concrete Co. first built their plant under an old coal-unloading trestle and put in a little electric trolley to carry the cement, sand and stone from the various bins to the mixer. With this plant they built an established reputation, so that they were able about a year ago to build a new one nearer the heart of town. Now both plants are in use. Something of the same story applies to the Boston Concrete Corporation, who do an excellent business with a many-times improved plant. Another similar example is the Scranton (Pa.) Ready-Mixed Concrete Co., Inc., who discovered an abandoned slag bank right beside the railroad and close to the heart of the city. They built a small plant and experimented, and now are putting the finishing touches to a new one.

Inspection by outside unbiased laboratories is being used more and more. This takes many forms, from ironclad certification in some of the large cities, through all varieties of near-certification, to just a few tests made at the smallest plants. In the larger plants there is excellent control of every operation by an outside inspector. Several years' experience with this method has "sold" it to the large producers as not only a good advertisement but a considerable saving in materials and trouble as well. The managements of middle-sized plants rather question the cost of certification and sometimes say that their contractors and engineers do not want to pay the extra cost of it. They incline more to regular inspection at longer intervals. Some have an unfortunate tendency to save too much. They object to spending eight or ten thousand dollars a year for certification, but go to the other extreme of only paying a few hundred dollars for inspection, not realizing that one or two thousand dollars a year would be a fair minimum for their research and would bring corresponding returns to them.

Most plants, however, are depending more and more on expert assistance in concrete control. They save money in buying the right material, in mixing it as economically as possible, and they gain the goodwill and confidence of the engineers and architects.

Arthur Dives, owner of a string of plants at Reading, York, Lancaster and Baltimore, uses both certification and ordinary inspection by an outside laboratory. "I consider certifying as insurance, especially in new territory," he says. "In York we have obtained probably 95 per cent of the concrete business by convincing the contractors and engineers that we are giving them the best there is in concrete. Besides, our laboratory man at the plant goes out on the jobs and irons out any little difficulties before they have time to get big. He also acts as a sort of consultant to the contractor or engineer on materials and methods to be used on the job. In the winter season he can show that it was not our fault that the concrete froze on the operation, and in summer he saves us a lot by making an agreeable adjustment with the builders as to how wet we may make the concrete."

Some Kinks About Plant Arrangement

There are a lot of valuable "kinks" that one picks up in these plants. They are too many and too technical for such a summary as this, but some should be mentioned. All the Transit-Mixed Concrete Corp. plants in New York City are on the waterfront. Stiff-leg derricks make the barge-to-bin transfer quickly and cheaply. A great many plants, also, are specially arranged so that the trucks can get their load without backing or interfering with other trucks. There is considerable economy in this.

The Transit-Mixed Concrete Corp. plant at Allentown, Pa., is planning a truck-wheel guide with a backstop so

SUMMARY OF INVESTIGATION O

City	Population in 1930	Name of Plant	Type	Biggest Run, in Cu. Yd.	Make of Truck Body	No. of Trucks	Truck Capacit in Cu. Yd.
Allentown, Pa.	92,563	Transit-Mixed Concrete Corp.	Transit	———	Paris	4	3
Boston	781,188	Boston Transit Mixer Co. (new plant)	Transit	600 average	———	30	3
Boston	781,188	Boston Concrete Corp.	Centrally-Mixed	800 in 24 hrs.	Clinton Blaw-Knox (open)	7 15	3
Bridgeport, Conn.	146,716	Silliman & Godfrey	Transit	325 in 12 hrs.	Paris	5	3
Bridgeport, Conn.	146,716	Bridgeport Concrete Co.	Central and Transit	650 in 10 hrs.	Rex	5	3
Easton, Pa.	34,468	Wm. Roberts Co.	Transit	60	Paris	2	3
Hartford, Conn.	164,072	Atlas Sand & Gravel Co.	Centrally-Mixed	500 in 10 hrs.	———	4	3½
Harrisburg, Pa.	80,339	Pennsylvania Supply Co.	Transit	350	Paris	6	4-2½–2-
New York City	6,930,446	Transit-Mixed Conc. Co. (Astoria plant)	Transit	800 to 1,000	Paris	10	5
Philadelphia	1,950,961	Liberty Corp.	Centrally-Mixed	———	Blaw-Knox (closed)	10	4
Philadelphia	1,950,961	Warner Company	Centrally-Mixed	2,000 (6 mixers)	Clinton	40 to 60	3½
Phillipsburg, N. J.	19,255	Steckel Sand & Gravel Co.	Transit	———	Jaeger	3	2½
Portchester, N. Y.	22,662	Westchester Certified Ready-Mixed Concrete Co.	Centrally-Mixed	650 in 8 hrs.	Rex	11	3½
Reading, Pa.	111,171	Reading Ready-Mixed Concrete Co. (old plant)	Centrally-Mixed	400	Clinton	6	2 and 3
Reading, Pa.	111,171	Reading Ready-Mixed Concrete Co. (new plant)	Centrally-Mixed	400	Clinton	4	2 and 3
Stamford, Conn.	46,346	Stamford Mason Supply Co.	Transit	———	Highway Mixer	4	1-1½ 3-2½
Scranton, Pa.	143,433	Scranton Ready-Mixed Concrete Co.	Centrally-Mixed	200	Clinton, Blaw-Knox	5	2 and 3
Wilkes-Barre, Pa.	86,626	Wyoming Ready-Mixed Concrete Co.	Centrally-Mixed	400	Clinton	9	3
Wilmington, Del.	106,597	Warner Company	Centrally-Mixed	370	Blaw-Knox	6 agitator and open	4
York, Pa.	55,254	York Concrete Co.	Centrally-Mixed	800 in 10 hrs.	Clinton	6	3

that when the trucks back into place they will be exactly in position and lose none of the dry mix, which is sometimes a failing of the transit system.

Silliman and Godfrey, at Bridgeport, Conn., have a small plant and use quite satisfactorily what is practically an asphalt weighing device. Stone, sand and cement are weighed one on top of the other.

Speaking of Bridgeport, when you next get to Connecticut, look up the plant of the Bridgeport Concrete Co. This is one of the finest plants in the East. Everything is under automatic control and in the winter the water is automatically held at 70 deg. F.

The Pennsylvania Supply Company, at Harrisburg, Pa., guarantee their concrete delivered at any part of town in winter to be not lower than 70 deg. F. The York (Pa.) Concrete Co. has found that a torch in the batcher, with preheated sand, is all the cold weather insurance needed. Some plants heat all materials, at considerable expense.

Simple Water-Measuring Device

One plant which shall remain nameless, mainly because the men at the plant might not like to be revealed as a small organization, has a very simple but satisfactory water measuring device. It is just an open tank with the gallons painted on the inside, from actual trial.

Why a Few Plants Are Not Profitable

Little needs to be said of the plants where things are not yet what they should be. Of course, we have not begun to mention all the good plants that are tabulated. The unfortunate plants are but a small percentage, but these few are rather amusing in their inefficiency. One supply man simply weighed his stone and sand separately in a truck on a truck scale, backed up the truck to the edge of a hill and shot the mixture with some cement into a transit type truck. This was merrily called "concrete" a few minutes later.

Another plant operator did the mixing by guess. Afterward, they weighed the mixture on their truck scale. One plant supplies sand and stone at the first truck stop, cement at the second and water at the third. It is admitted that every plant must get its start, to overcome competition, and undoubtedly these plants are in the throes of development.

Much more could be written to advantage on these plants. Nothing has been given on the economic side—costs, management and overhead. These were less easy to obtain on a first visit, and what was learned deserves space by itself. It is enough to say in closing that these plants represent fairly the premixed concrete industry in the East.

WENTY READY-MIXED CONCRETE PLANTS

				Testing			
ixer Capacity in Cu. Yd.	Scales	Water Device	Conveyor System	Certified	Frequency	By	Aggregate Testing
3	Fairbanks Overweigh	On truck	Blaw-Knox	No	None	—	None
3	Howe Weighto	Tank Vol.	—	No	2 or 3 days a week	Skinner	Yes
2	Howe Weighto	Tank Vol.	Blaw-Knox	No	2 or 3 days a week	T & L	Yes
Batcher only	Johnson	—	Crane	No	—	—	—
3	Kron	Tank and truck	Stems belt	No	—	—	—
None	Truck Scales	On truck	None	No	—	Lafayette College	No
1½	Jaeger	Tank Vol.	Bucket	No	—	—	—
Batcher	Howe	On truck	Stiff-leg derrick	No	No	No	No
5	Fairbanks	On truck	Blaw-Knox	When nec.	In case of question	PTL	Some
4	Howe Weighto	—	Screw	Yes	—	Julius Adler	Yes
2½ and 3½	Howe	Tank Vol.	Blaw-Knox	Yes	24 cyl. daily for 4 mixes	Conwell	4 times daily 4 finenesses
Batcher	Truck Scales	On truck	Brought on top by truck	No	—	—	—
4	Winslow	Tank	Blaw-Knox and stiff-leg	Yes	Part time	Haller	—
2	—	Tank Vol.	Electric trolley	No	Daily	ATL	No
2	Winslow Overweigh	Tank Vol.	Butler Service Supply Co.	No	Daily	ATL	None
Batcher only	None	On truck	Crane from boat	No	—	—	—
1	Hauk and Fairbanks	Ransome	Crawler derrick	No	Frequent	—	—
2	Butler and Winslow	Ransome	Stiff-leg	No	—	—	—
2	Howe Weighto	Tank Vol.	Laterman	Yes	12 cyl., 2 mixes	Conwell	1 fineness sand on each barge
2	Howe Weighto	Ransome	Stiff-leg derrick	Yes	1 for 3 loads	Conwell	Yes

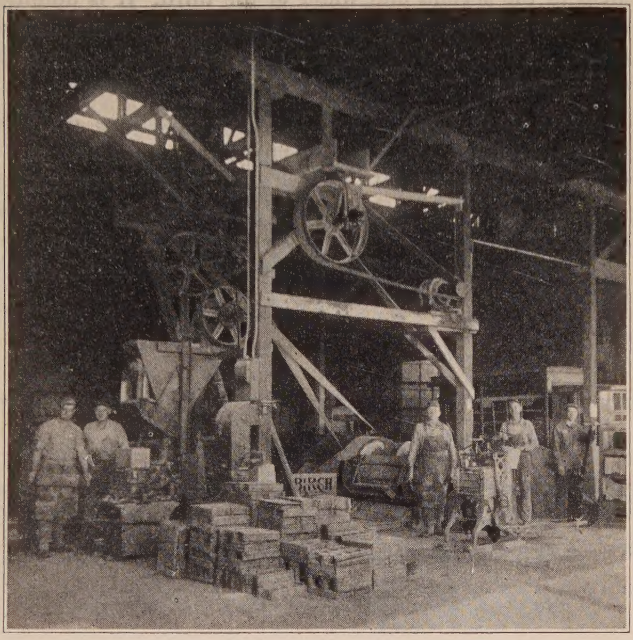
Concrete Products Manufacturer Departmentizes His Business

Domhoff Plant in East St. Louis Well Equipped to Make Various Kinds of Products

The concrete products plant of John F. Domhoff, of East St. Louis, Ill., has for 27 years produced concrete masonry building units in substantial volume.

Like some other products manufacturers, however, Mr. Domhoff has turned more and more towards specialties without in any way neglecting his masonry building unit lines.

In line with this policy he has built up a large business in the field of concrete burial vaults, and a fair volume in chimney block and other special products. Burial vaults are featured in the large sign on one side of the plant.



The East St. Louis plant of John F. Domhoff.

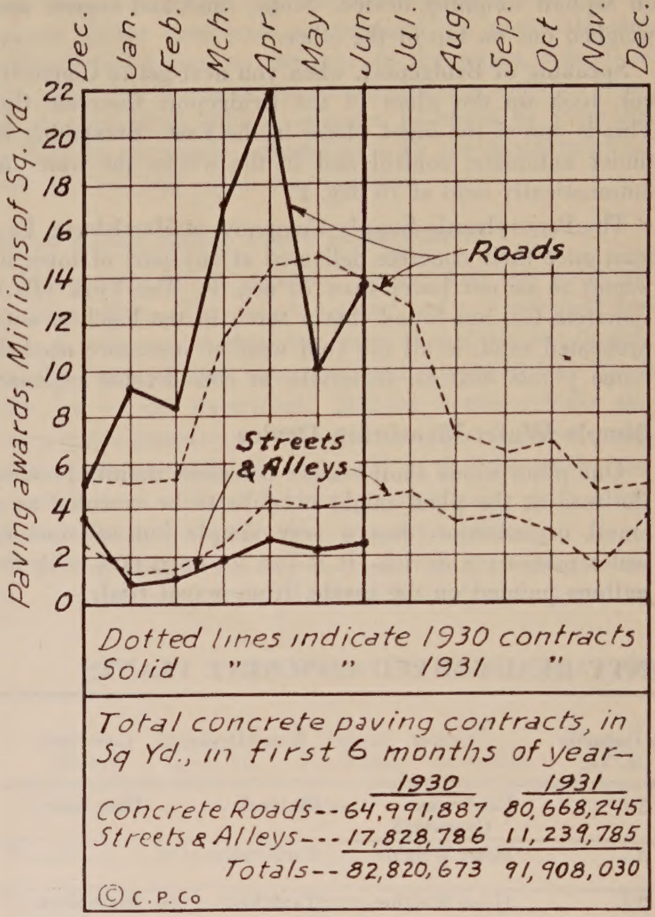
The interior of the Domhoff plant is shown in the illustration. The block-making machine in the left center is a Multiplex power stripper.

Concrete Highway Awards 24 Per Cent Above First Half of 1930

The yardage of contracts for concrete roads awarded in the month of June totaled 13,535,625 sq. yd., practically equal to the total of 13,859,893 sq. yd. in June, 1930, according to figures compiled by the Portland Cement Association. This brings the total of concrete highway awards to 80,668,245 sq. yd. in the first 6 months of 1931, far in excess of the showing in any previous year, and 24.3 per cent above the 64,991,887 sq. yd. awarded in the first 6 months of 1930. Contracts for all concrete pavements, including roads, streets and alleys, are 11 per cent ahead of last year in the 6-month period.

Contracts for concrete street and alley pavements totaled 2,421,510 sq. yd., compared with 4,295,744 sq. yd. in June, 1930. The diagram shows the street and alley curve to be following the same general trend as in 1930, but at a lower level.

General Construction Contracts. Contracts for general construction work in the 37 states east of the Rocky Mountains are reported by the F. W. Dodge Corporation at $331,879,700, compared with $306,079,100 in May. For the first 6 months of this year the total contracts for general construction work amounted to $1,808,226,800, compared with $2,638,013,300 in the first 6 months of 1930. The New Orleans territory stands out conspicuously as the only one of the 13 Dodge territories showing a gain in the first 6 months of 1931 as compared with the corresponding period of last year.



Dotted lines indicate 1930 contracts
Solid " " 1931 "

Total concrete paving contracts, in Sq Yd., in first 6 months of year—

	1930	1931
Concrete Roads	64,991,887	80,668,245
Streets & Alleys	17,828,786	11,239,785
Totals	82,820,673	91,908,030

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Quality Control of Concrete on a Small Job

Modern methods of controlling the quality of concrete need not be confined to large contracts. The same principles of concrete-making can be applied to the small job as well.

The equipment employed on the small contract must, of necessity, be more simple and less expensive than on the larger project; but the final product—the concrete—can be of equal quality in both cases.

How this was accomplished by an Illinois contractor will be described soon.

Estimating Cost of Concrete Work

Taking Off Bar Reinforcement—Cost of Placing Steel—Price Differential on Smaller Sizes—Finishing Exposed Surfaces—Cost of Floor Finish

III—Steel Reinforcement—Finishing

By LESLIE H. ALLEN
Aberthaw Company, Boston, Mass.

Methods of handling reinforcement have changed considerably in the last few years. It used to be the custom to buy bars direct from the mill and cut and bend them on the job. The usual method now is to buy the bars ready cut and bent from a bar company, who will quote a lump sum for all the steel required on the job. All the contractor has to do is to unload and place the steel in the forms.

The estimator should, however, be able to take off his own quantities and price them, as occasions will often arise where he cannot summon the assistance of the bar companies.—*The Author.*

STEEL bars are first measured by the lineal foot, each size being kept separate. The total length of each size bar is then multiplied by the weight per lineal foot. These weights are as follows:

Size	Square	Round
1¼ in.	5.33 lbs.	4.17 lbs.
1⅛ in.	4.3 lbs.	3.4 lbs.
1 in.	3.4 lbs.	2.67 lbs.
⅞ in.	2.6 lbs.	2.05 lbs.
¾ in.	1.91 lbs.	1.51 lbs.
⅝ in.	1.33 lbs.	1.04 lbs.
½ in.	.85 lbs.	.67 lbs.
⅜ in.	.48 lbs.	.38 lbs.
¼ in.	.22 lbs.	.17 lbs.

In measuring the required length of bars be careful to allow for hooked ends, laps, and negative steel.

Footing reinforcement is generally hooked at each end. The length of each bar is about 8 in. more than the length of the footing. Thus, if a footing is 6 ft. sq. and 2 ft. 0 in. thick, reinforced with 1 in. bars 6 in. on center each way, the steel required will be 22 bars each 6 ft. 8 in. long.

Dowels and column steel usually lap each other forty diameters. For example, if the column above this footing is 24 in. sq. and 12 ft. high and requires eight 1 in. bars, there will be eight footing dowels 5 ft. long, this length being 1 ft. 8 in. from top of footing steel to top of footing, plus 3 ft. 4 in. (40 diameters) for the lap with the column steel.

Column Steel

The column steel will be 15 ft. 4 in. long, including 12 ft. 0 in. for height of column plus 3 ft. 4 in. for lap with second floor column steel.

The length of each hoop for this column will be the perimeter of the core, 20 x 20 in., plus 6 in. for laps, or a total of 7 ft. 2 in. If they are spaced 12 in. apart there will be eleven of them.

The spiral steel for circular columns is measured by multiplying the diameter of the core by the number of turns, allowing an extra turn at the top, and multiplying by the weight of the bar and then adding thereto the weight of the spacer bars, which usually run about 2 lbs. per lineal foot of column.

Example—A 24-in. circular column (with 20-in. core), 12 ft. high, reinforced with eight 1-in. round bars and spirals 20 in. diameter, 3 in. pitch, will require—

1″ round bars 15′4″ × 8 × 2.67 lbs. = 327 lbs.

Spirals 5′3″ × 49 × .376 lbs. = 99 lbs.
Spacers 12′0″ × 2 lbs. = 24 lbs.

Total spirals = 123 lbs.

Beam and Girder Steel

A typical beam or girder will contain some bent and some straight bars. The straight bars in the bottom extend over the column 12 in. or more beyond, but the bent bars will extend over the centers to the quarter point of the beam in the next bay.

Example—A beam is 12 in. by 24 in.; column 18 in. by 18 in.; spacing 15 ft., reinforcement five round bars, two straight and three bent, and twelve stirrups.

Straight bars will be 18 ft. 6 in. long.

Bent bars will be 25 ft. 6 in. long, 15 ft. net length plus 3 ft. 9 in. at each end to go to the quarter point of the next bay, plus twice 1 ft. 6 in. for bends in center.

Stirrups for this beam will each be 5 ft. 1 in. long, including the bottom of 9 in., two sides each 20 in., and two hooks at top each 6 in.

If the beam ends at an exterior column the bent bars will each have one end hooked instead of a 3 ft. 9 in. lap. Length will be 22 ft. 9 in., including 15 ft. plus 3 ft. 9 in. to quarter point at one end, plus 1 ft. for hook, at other end, plus twice 1 ft. 6 in. for bends at center.

Steel in Floor Slabs

Straight floor steel in floor slabs presents no difficulties. Negative steel in slabs over beams is usually in the form of additional straight bars equal in length to half the span of the slab. If slab steel is bent up to act as negative steel the method of measuring is the same as described for beam steel.

Placing Reinforcement

The labor of placing reinforcement is generally done by a sub-contractor who will quote an inclusive price per ton for unloading, placing and wiring bars in position. The usual price for this service is from $15 to $25 per ton, according to the character of the work.

The bar companies' price for material is made up about as follows:

Steel bars, mill price, say	$40 per ton
Freight	8 per ton
Differential (average)	2 per ton
Scheduling	1 per ton
Cutting and bending	6 per ton
Total	$57 per ton

The mill price of steel is subject to sharp fluctuations and the charges for scheduling, cutting and bending vary in accordance with the type of job. A building with a very irregular layout, or one with a large proportion of small sized bars, or with an unusually large amount of bent bars, may cost a good deal more than the figures given above.

Price Differential Applied to Smaller Sizes

The cost of steel bars smaller than ¾-in. is higher than the larger sizes. This difference in cost is called the "differential."

Present differentials are as follows:

⅝″—base price plus	$ 2 per ton
½″—base price plus	4 per ton
⅜″—base price plus	8 per ton
¼″—base price plus	20 per ton

Spiral steel for circular columns will cost about $30 per ton more than other steel.

Mesh Reinforcement

Wire mesh and welded fabrics are purchased by the square foot. In measuring mesh be sure to allow for laps at the ends and sides of the sheets. Ten per cent is the customary allowance.

The cost of mesh reinforcement varies from $1 to $5 per 100 sq. ft., according to its size and weight. The cost of placing should not exceed $1 per 100 sq. ft.

Specialties

In addition to the bar steel shown on the plans, architects' specifications will call for special high chairs and spacers to insure accurate placing of reinforcement. Quotations on these specialties will be obtained from the manufacturers; the cost may run from $1.50 to $4 per ton of bars placed.

FINISHES

Most architects will specify that when forms are removed, the surface of the exposed concrete shall be patched where voids or stone pockets are found and that projecting "fins" shall be removed. This work is usually done by cement finishers, who should be able to go over 100 sq. ft. in an hour at a cost of $1.50 per 100 sq. ft.

If poor quality lumber is used, or if form work or spading of concrete is carelessly done, this figure may be two or three times as high.

If specifications also call for surfaces to be rubbed with carborundum, add $4.00 per 100 sq. ft. for each rubbing.

Measurements for the areas to be patched and rubbed are quickly obtained by adding together all the form areas (except footings and other concealed work).

Top surfaces of floor and roof slabs are generally floated or finished in granolithic. Floating of roof slabs can be done for $2.00 per 100 sq. ft.

Granolithic Floor Finish

Granolithic trowelled finishes are a separate operation. The following amounts of material will be required for 100 sq. ft. of granolithic finish:

1″ thick: 1.25 barrels cement	@ $2.00 =	$2.50
.5 tons sand	@ 1.00 =	.50
Total material		$3.00

If fine crushed (pea) stone is specified, figure—

1.25 barrels cement	@ $2.00 =	$2.50
.25 tons sand	@ 1.00 =	.25
.25 tons pea stone	@ 3.00 =	.75
Total material		$3.50

The labor of mixing, placing, and trowelling granolithic finish is about $5.00 per 100 sq. ft., if sand only is used; or $6 if pea stone is required. If granolithic is laid after the slab has set, add $2 per 100 sq. ft. for picking and cleaning the surface of the slab.

For outside finish which may be damaged by rain or by careless passers-by, add something for paper or sisalkraft protection. Paper can be bought for 50 cents per 100 sq. ft. Sisalkraft will cost about $1, but can be re-used two or three times. The labor of placing and removing protection should not exceed 50 cents per 100 sq. ft.

Coming Conventions

September 6-12—New International Association for Testing Materials, First International Congress. Swiss Federal Polytechnicum, Zurich, Switzerland.

October 12-16—National Safety Council, 20th Annual Safety Congress and Exposition. Chicago, Illinois.

January 9-15—American Road Builders Association, twenty-ninth annual convention and road show. Detroit Airport Building, Detroit, Mich.

January 25-26—National Ready-Mixed Concrete Association, second annual convention, William Penn Hotel, Pittsburgh, Pa.

January 27-29—National Sand and Gravel Association, sixteenth annual convention, William Penn Hotel, Pittsburgh, Pa.

Profitable Manufacture of Concrete Building Units

Measuring Devices for Both Aggregate and Water Are Essential—Mixer Capacity and Time of Mixing and Their Relation to Production—Ideal Tamping Action

VIII—Mechanical Manufacturing Problems

By FRED A. SAGER
Consulting Industrial Engineer

In this chapter Mr. Sager urges the use of proper mechanical devices as important in assuring uniformity and securing a quality product.

He also tells in detail how the assumed production can best be secured as far as the mix and the mixing equipment are concerned.—The Editors.

THE mechanical problem in manufacture is concerned with the equipment and plant layout necessary to carry out in practice the technical requirements for the making of a suitable product at a minimum cost.

Measuring Devices Should Be Used

The matter of proportioning aggregates and of mixing has been given continually increasing attention during the past years. Early plants employed crude methods of determining the mix and of mixing as well, with resulting variations in the quality and texture of the finished product. Even in recent years large plants have been noted, in which the charge of aggregate in the mixer was determined by the eye and judgment of the mixer man. The superintendent reported that the skill of the mixer man was such that the record of blocks per sack of cement ran very close from day to day. While this may have been the case, there was still no positive assurance of the uniformity of each batch; and particularly in a large plant, with overhead storage for aggregate, where measuring boxes could easily be installed between storage bins and mixer, the omission of this inexpensive assurance of uniformity of proportions for each batch, was a matter of surprise. Where two sizes of aggregate are used the necessity for measuring is still more important.

Measuring boxes, used either to control the volume or the weight, serve as a more accurate means to secure uniform proportioning of the aggregates. The proper proportions of aggregates and cement must be determined by calculation and test runs, after which these proportions can be maintained by the measuring devices and the quality of the product controlled so far as the mix is concerned.

Measuring the Water

Attention should also be given to the amount of water used in mixing. The uniformity of batch after batch is best maintained where the water is measured. This is done in some plants by an indicating water meter. An adaptation of the fittings of an ordinary flush tank can easily be made to serve this purpose, and will measure the water automatically. The idea is illustrated in Diagram 10. The device as shown has a water box 7 by 11 in. inside dimensions, which gives a capacity of 1 gal. of water for 3 in. of height, and a total discharge, for the 20 in. difference of water level shown, of 6⅔ gal., with a range in the amount of discharge of from zero to the full discharge. "A" is a float of an ordinary float valve and the upper level of water in the tank when full, is fixed as indicated in the diagram. The water is retained in the tank by the usual ball valve "B" of a flush tank. This ball valve is mounted in the lower end of a rod to which are attached a couple of float balls, "C," whose combined buoyancy is sufficient to float the rod with the ball valve "B" attached where "B" is raised from its seat, so that the hydrostatic pressure is exerted on its under side.

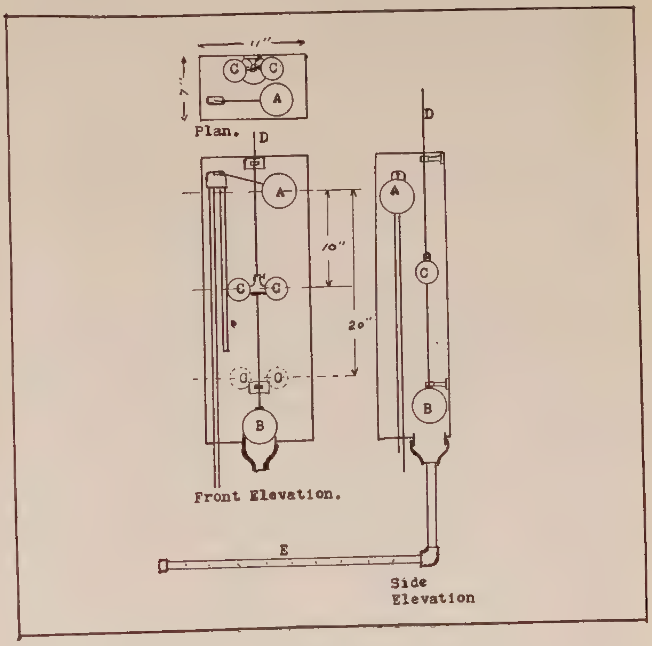


Diagram 10. Water measuring device

The Mixing Operation

First discharge the measured aggregates in the mixer and allow 15 seconds for dry mixing, the turning or spading action of the mixer producing a uniform distribution of coarse and fine pieces of aggregate. Then add the cement, rather slowly—that is, during two or three revolutions of the mixer—spreading it from end to end rather than dumping the entire bag in one pile in the mixer. A few more revolutions of the mixer should then secure a fairly uniform distribution of the cement and would continue the mixing of the aggregate.

The water can next be added and the mixing continued for the allotted time. The above process would require less than one minute for the mixing of the aggregates and the adding of the cement.

As to the time of the wet mix, nothing more can be suggested in this regard than was set forth in the last article, namely, a minimum of 5 minutes of mixing. Certainly if attention is given to a proper distribution of aggregates and cement and water as they are delivered to the mixer, this time should produce a uniform concrete.

Mixer Capacity

For the plant capacity assumed, of 1200 8-in. units per day, a rate of 240 units per hour may be taken as the normal maximum rate of production, or 1 unit in 15 seconds. With a mix of one sack of cement for 17 units, and with a 2-bag mixer, a batch will be required every 8½ minutes, which indicates that a 2-bag mixer would be satisfactory. With the mix yielding 22 units per sack of cement, the average time between mixes would be 10 minutes. Throughout this range the 2-bag mixer would be satisfactory for a 5-minute mix, though with the larger yield the mixer might well be dumped at the end of the 5-minute mixing period in the interests of saving in power consumption and of wear and tear on the mixer.

Block-Making Equipment

In products manufacture, with the dry mix used, considerable force must be applied as direct pressure or by tamper blows to properly compact the concrete. For a uniform product this compacting should be uniform throughout the mass of the unit.

In the case of the older pressure-type block machines with the mold full and pressure applied at one end by a piston, arching action tended to deflect the downward pressure of the piston at an angle, resulting in pressure and added friction on the sides of the mold. In modern pressure-type machines this tendency is overcome, providing a piston at the bottom of the mold that rises, after the compacting of the upper part of the block has been accomplished, by the downward movement of the upper friction. By this process of compacting from each end of the mold a satisfactory block is made, as is evidenced by tests of the units. The appearance of the unit is improved since it is finished on all sides.

With the tamping type of machine and the mold box full as tamping begins, the same arching action is present and the top of the block is compacted more than the bottom. The proper use of the tamping type of machine requires the molds to be filled as the tamping proceeds, and it has been demonstrated that a limited number of tamper blows are sufficient for the proper compacting of the unit. One test with cinder concrete indicated full strength with from 8 to 12 tamper blows and decreasing strength with from 15 to 20 blows. No comments were received with the above results, but the following is offered as a possible explanation. The writer knows that with certain cinders excessive tamping results in further crushing of the aggregate, and if such breaking of pieces of the aggregate occurs in the mold box, these freshly broken areas are not coated properly with the cement mortar. Possibly this may account for the decrease in strength indicated by the tests referred to above.

The ideal tamping machine would feed a uniform layer of concrete into the mold, deliver one tamper blow of force sufficient to compact this layer, and then continue this process until the mold is filled, with a final blow on the excess material in the hopper, then no more tamper blows.

Uniform Feeding An Essential

It is essential that the material be deposited with reasonable uniformity over the whole area of the mold by the feeder, whether shoveled in by hand or delivered by automatic feeder. This is particularly the case when making two 4-in. units at a time on a machine with the tamper feet for the two units attached to the same tamper rod. In case the material is fed to one unit faster than to the other, that unit will be compacted more than the other in the lower portion.

With machines making 80 revolutions per minute, from 15 to 25 tamps are frequently used per block, when a better unit can be made in half the time with from 7 to 10 tamps. Uniform rate of feed can be obtained with one of the several types of automatic or semi-automatic feeders available. In case of an old plant with no provision for power feeders, a simple hand feeder, consisting of a push plate in the bottom of a hopper, can be built at little expense. It will fill the mold in from 4 to 6 movements of the push plate, the distribution of the material to the front or back of the mold being regulated by the speed with which the plate is moved forward.

The matter of manufacture and curing the product will be concluded in the following article.

Benedict Stone Products Company Becomes Affiliate of Massey Corporation

An Illinois corporation has been formed known as Benedict Stone Products Co., which has taken over the assets of Benedict Stone Incorporated, manufacturers of cast stone.

Benedict Stone Products Company is closely affiliated with Massey Concrete Products Corporation. The general offices are located at 122 South Michigan Avenue, Chicago.

J. W. Lowell, who becomes vice-president of Benedict Stone Products Co., has for many years been prominently connected with the development of "Benedict Stone" and is largely responsible for its success. Mr. Lowell has had a very wide experience in the concrete field, particularly while engaged in research work for the Universal Atlas Cement Company.

The other officers of Benedict Stone Products Company are, president, J. S. Hobson; vice-president and general manager, G. H. Redding; secretary and treasurer, B. F. Landers.

EDITORIAL

The Next Ten Years

DELEGATES and visitors attending the thirty-fourth annual meeting of the American Society for Testing Materials could not fail to be impressed with the increasing importance given to problems pertaining to cement, concrete, and concrete aggregates, and to products made from these materials.

The unusual activity, during the past year, of Committee C-9 on Concrete and Concrete Aggregates, under the chairmanship of Cloyd M. Chapman, was reflected in the number of excellent papers presented in the committee's 118-page report, supplemented by several papers not included in the main report.

Committee C-1 on Cement likewise has widened out its program, under the chairmanship of P. H. Bates, and has effected a reorganization which has served to facilitate the committee's studies of high-early-strength and standard portland cements, as well as masonry and plastic cements.

In the realm of concrete products the A. S. T. M. meeting was unusual in the number of papers and reports presented. The wall stability tests at the University of Illinois, the fire tests at the research laboratory of the Portland Cement Association, and the work of Committee C-10 toward the development of a tentative standard for concrete masonry building units, all served as major subjects for papers or reports.

The vast amount of work accomplished in the study of problems associated with concrete, with the materials and processes that enter into the making of concrete, and with products made from concrete, will have a large influence on the science of concrete-making during the important ten years just ahead.

Saving Life, Time and Money

CATCHING up with the automobile is the sincere endeavor of a growing number of local communities, cities and states. Although automobile registrations are halted at present around 26,000,000 vehicles, the construction of highway facilities must go on at a fast pace, for motor usage and motor accidents are increasing.

In no other department of highway construction can the expenditure of funds accomplish as much good as in the elimination of grade crossings. It is therefore especially gratifying that so much is being accomplished in this direction.

Recent announcement has been made of the early construction of a number of impressive highway structures which indicate safer days for motor traffic.

Twenty-two railroad grade crossings will be eliminated in Elizabeth, N. J., at an estimated cost of $10,000,000. The Erie Railroad has already started demolition of buildings to make way for the mile-long concrete viaduct which will eliminate 18 of the crossings.

In Wisconsin the possibility of motor cars making contact with railroad trains is being made impossible at 22 crossings. Contracts for six more overhead crossings will be let soon, and by the end of the year Wisconsin will have built or placed under contract eighty such structures.

From New York, New Jersey, Pennsylvania and Indiana news reaches us of large programs involving grade separation.

In Illinois, Chicago and Cook County are making special efforts to complete a program of some forty grade separation structures.

Grade separations accomplish a two-fold purpose. They eliminate traffic delays and they reduce traffic accidents. Both purposes are worthy of the best efforts of state and county highway departments.

For the Attention of Convention Planners

IT is not too early to consider the time and place for next year's conventions for those organizations which have not already announced their dates.

Neither is it too early to consider a change in convention policy for the smaller organizations in the concrete industry.

For very good reasons the officers of the smaller organizations have hesitated to meet in conjunction with a large, but allied, association. The larger association overshadows the smaller one so completely that the latter's sessions are not well attended.

But why, on the other hand, can not a group of five or six smaller organizations, having at least some problems and some membership in common, meet in the same city during the same week? If negotiations were started now by the officers of such a group, the days of that week could be assigned in such a way as to cause very little conflict and considerable mutual benefit. The arrangement would permit delegates to attend several conventions on one trip, at a great personal saving in both time and money.

Someone must initiate this plan. Associations which could logically have their conventions grouped in this manner can readily be selected by any organization secretary who takes the trouble to make up a list of those related to his own. The list of "Organizations" published in each issue of "Concrete" will serve as a start.

The trade association secretary who takes the initiative will perform a distinct service to the members of his own organization as well as four or five others.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Central and Truck-Mixed Concrete

A 24-PAGE pamphlet issued by the American Road Builders' Association as Bulletin No. 16, under the title of "Central and Truck-Mixed Concrete," presents a thorough study of a committee appointed by that organization early in 1930. The report was presented and discussed at the St. Louis convention of the A. R. B. A. in January, and is now made available in printed form.

After reviewing the data received from all sources, the committee has arrived at the following fourteen conclusions:

1. Ready-mixed concrete, manufactured under proper supervision, is acceptable for all types of concrete construction.
2. The ready-mixed concrete plant should be equipped with weighing devices, meeting the specification of the American Road Builders' Association for weighing devices for concrete aggregates, and as used by various state highway departments.
3. For low slump concrete, the "non-agitating" type of truck is satisfactory as hauling equipment under proper supervision and gradation of aggregates.
4. Specially designed watertight bodies with rounded corners should be required when open type dump bodies are used.
5. The so-called "agitator" type of bodies have proved satisfactory for hauling concrete of any slump under proper supervision and gradation of aggregates.
6. Satisfactory concrete can be secured by truck mixers provided proper supervision and gradation of aggregates is exercised.
7. The use of central mixing plants, the transportation of mixed concrete and the use of truck mixers may be permitted provided there is no segregation of material when the concrete is deposited on the subgrade.
8. The concrete may be hauled not to exceed one hour, except by special permission of the engineer, and must reach the subgrade in such plastic and workable condition that the slump, on the job, is within the limits specified.
9. Any concrete which is not plastic and workable when it reaches the subgrade should be rejected.
10. It may be pointed out that there is generally a change of slump with the elapse of time after mixing. This should be taken into consideration in arriving at a suitable water-cement ratio applicable to each job. In this respect complete co-operation is necessary between the engineer and the operator.
11. The methods of transferring the product from the hauling unit and depositing same on the subgrade have been discussed as well as the protection of subgrades requiring such protection.
12. Where no mesh reinforcing is used, it is suggested that light steel channels be used for truck runways. These channels should be in sections preferably 5 ft. in length. Where reinforcing mesh is used, portable swivel type conveyors to take care of at least 20 ft. of subgrade should be utilized.
13. The use of bulk cement frequently presents an economical, and, from an engineering standpoint, thoroughly satisfactory operation. However, the decision in this matter should be reached after an investigation as to the adaptability of the project to be constructed to such a method.
14. Engineers, in permitting the use of ready-mixed concrete should, at all times, satisfy themselves that the operator is sufficiently equipped both from the standpoint of personnel and mechanical equipment, to produce and deliver the product in sufficient quantity and of a quality which is acceptable.

Copies of this excellent report may be obtained by addressing the American Road Builders' Association, 914 National Press Building, Washington, D. C.

Contractors' Pump Standards

A printed specification headed "Contractors' Pump Standards" has been adopted and issued by the Contractors' Pump Manufacturers Bureau, 630 Munsey Building, Washington, D. C.

These standards include two sizes of road pumps and three sizes of diaphragm pumps. The standards have been approved by the Associated General Contractors of America, which has authorized the placing of a standard rating plate bearing its seal upon each unit manufactured in accordance with the standards.

The Contractors' Pump Manufacturers Bureau is affiliated with the Co-operative Construction Bureau of the Associated General Contractors of America. The following companies compose its present membership: Barnes Manufacturing Co., Mansfield, Ohio; Chain Belt Company, Milwaukee, Wis.; C. H. & E. Manufacturing Co., Milwaukee, Wis.; Domestic Engine & Pump Co., Shippensburg, Pa.; Jaeger Machine Company, Columbus, Ohio; Marlow Manufacturing Co., Ridgewood, N. J., and Novo Engine Company, Lansing, Mich.

Copies of the printed standard may be obtained from the Contractors' Pump Manufacturers Bureau.

Sturdy Methods of Fabricating and Testing Reinforcing Bars

THE Rail Steel Bar Association, 228 No. La Salle Street, Chicago, acting in co-operation with a committee representing the Highway Research Board, has completed a series of tests under the direction of the bar association's committee on metallurgy. The tests included a comparison of fabricating and testing methods for reinforcing bars.

An interesting feature of this work comprised an analysis of a complete run of rail steel bars to determine the uniformity characteristics. The investigation also included a metallographic study of the effect of various methods of bending bars.

This investigation is a part of the Rail Steel Bar Association's program of co-operative research and production development.

Test Aerocrete Floor Construction

Procedure and Results in Official Tests in Chicago—Composite Floor Construction Found Satisfactory—Panels Loaded to Destruction After Official Tests

The July issue of "Concrete," pages 17 to 19, contained brief descriptions of several tests on aerocrete floor construction conducted under the supervision of the Bureau of Buildings, Borough of Manhattan, New York City, and a more detailed description of floor panels tested in Chicago early this year, under the supervision of a committee of engineers acting as official representatives of the city.

In this issue the test methods and results are given. The final installment will set forth the conclusions and recommendations of the committee of engineers.—The Editors.

THE test floor panels shown in Figure 3, on page 18 of the July issue of CONCRETE, were built in an abanboned and unheated building near the corner of Orleans Street and Carroll Avenue, in Chicago, and were tested during the period from January 6 to 12, 1931. Both the test floors and the building have since been removed.

The plan in Figure 3, printed in the July issue, shows how the test panels were divided into four parts, designated as Test No. 1, Test No. 2, Test No. 3 and Test No. 4. The part designated as Test No. 2 was the welded part of the test structure. The part shown as Test No. 1 had its steel members riveted and continuous. Test Nos. 3 and 4 show panels with non-continuous (or simple) spans.

Load Test on Bare Steel Beams

After the erection was completed a load test was made on the bare steel beams, so that deflections resulting from this test might be compared with deflections under comparable loads after the aerocrete was in place and hardened. Bags of sand weighing 100 lb. each, and supported on a timber cribbing, were used for this test. The load was applied so as to represent increments of 25 lb. per sq. ft. over the floor panel. The cribbing consisted of 6 by 6-in. by 6-ft. timbers spaced 12 in. center to center. The final loading was equivalent to 112½ lb. per sq. ft. considered as over the entire floor panel construction.

A complete record was made of the results of the load tests on the bare steel beams.

Construction of Forms

The next procedure was to install the form work for the aerocrete. The form work was completely supported from the structural steel frame by wires and straps. The forms, for the most part, were built in sections, 18 in. wide and 6 ft. 4 in. long, and consisted of wall board attached to a wood frame. The sections were bolted and nailed together in a manner that permitted easy and rapid removal.

The form work was detailed so as to allow 2 in. of covering on the bottom and sides of the structural steel, as may be seen in Figure 4.

Load Test on Completed Structure

The official load test was made on the completed test panels in accordance with the requirements of the tentative new building regulations of the city of Chicago. Those regulations provide that the floor panel shall carry a test load equal to the design live load plus 1½ times the dead load of the floor. The dead load had been estimated at 56 lb. per sq. ft., and the design live load was 100 lb. per sq. ft., so that the required test load was 184 lb. per sq. ft.

It was determined later that the actual dead load, in-

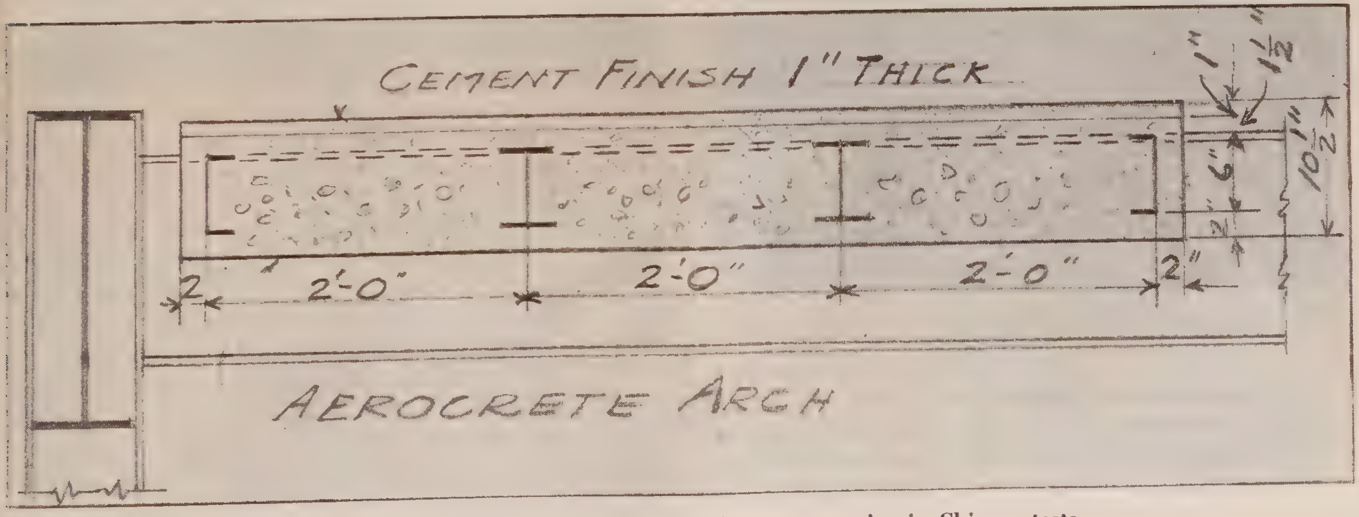


Figure 4. Cross-section of completed floor construction in Chicago tests

cluding the cement mortar floor topping and the steel beams, was 62 lb. per sq. ft., which would have required a test load of 193 lb. per sq. ft.

In view of the convenience of applying the load in increments of 25 lb. per sq. ft., it was decided to use a test load of 200 lb. per sq. ft. in the official test.

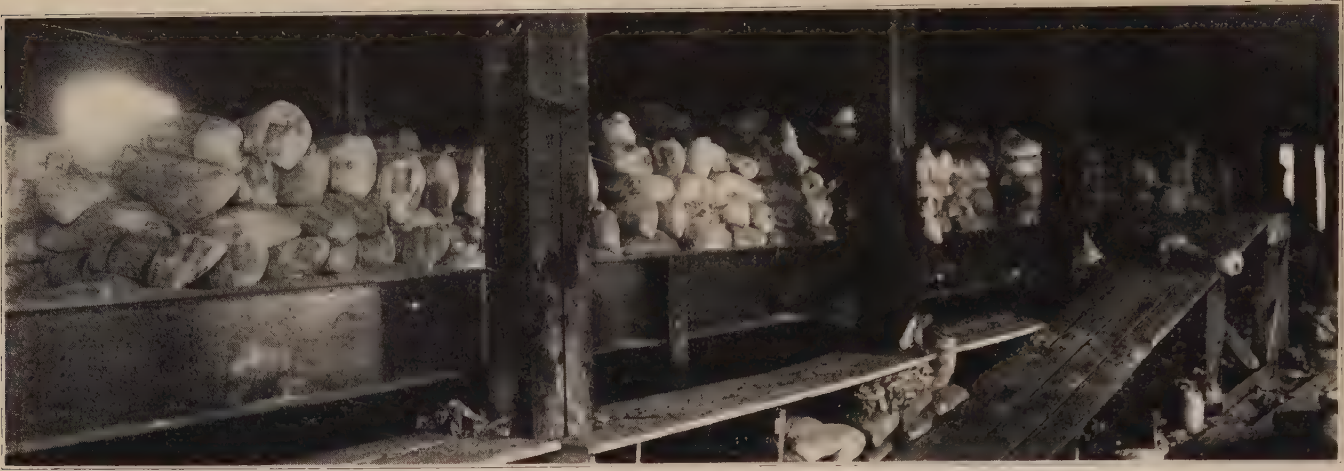


Figure 5. Official test load of 200 lb. per sq. ft. in place

The deflection permitted by the tentative new building regulations of Chicago is indicated by the formula—

$$\frac{\text{Deflection in feet}}{\text{Span in feet}} = \frac{0.001 \times \text{Span in feet}}{\text{Slab thickness in inches}}$$

In this case the span was 24 ft. and the total slab thickness, including the 1-in. topping, was 10½ in. Consequently, the permissible deflection was 0.66 in.

The tentative Chicago regulations contain the further provision that if, after 24 hrs. of continuous loading, the permissible deflection is exceeded, the load shall be removed and the panel left unloaded for 24 hrs. If, by this time, the panel has recovered 75 per cent of the deflection under load, it will be considered as having passed the test.

The records of deflections and stresses were obtained through deflectometer measurements at 18 points, and through extensometer readings at 40 points at the bottom of the steel beams, 12 points at the top of the steel beams, 8 points at the top of the mortar floor finish, and 10 points at the bottom of the aerocrete.

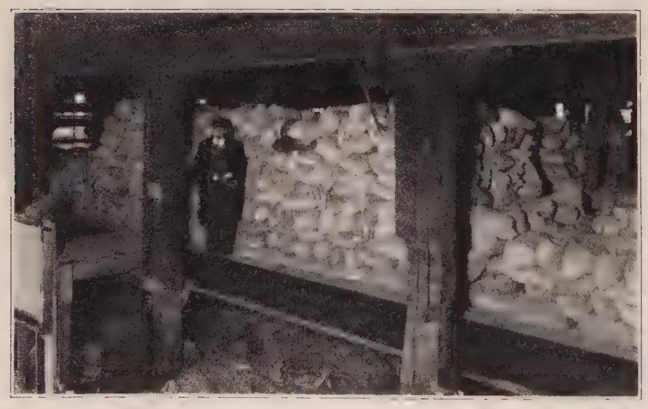


Figure 6. Load of 500 lb. per sq. ft. on center panel and 212½ lb. on end panels of Test Nos. 1 and 2

All Panels Pass Test

The average deflection at the center of the spans, after the test load of 200 lb. per sq. ft. was in place for 24 hrs., was 0.65 in. in Test No. 1, and 0.59 in. in Test No. 2. Both of these tests were on continuous sections.

In the simple spans, represented by Test No. 3 and Test No. 4, the center deflections were 0.96 in. and 1.005 in., respectively. These two values both exceeded the permissible deflection of 0.66 in.; but the former panel recovered 81 per cent and the latter 83 per cent of its deflection under load, so that the requirements of the test regulations were fulfilled.

The official test load of 200 lb. per sq. ft. is shown in Figure 5.

Panels Loaded to Destruction

After the official test was completed, the panels were loaded to destruction. With a load of 550 lb. per sq. ft. on the interior panel and 187½ lb. per sq. ft. on the end panels, Test No. 2 failed. This was the continuous welded section. The failure was primarily a bending failure in the beams at the center of the interior panel, followed immediately by tension failure of the welded straps over the interior supports.

At the time that Test No. 2 failed, Test No. 1 had a load of 500 lb. per sq. ft. on the interior panel and 212½ lb. on the end panels. The impact from the failure of Test No. 2 caused failure of Test No. 1 (the continuous riveted section) at this slightly lower load. Test No. 1 also failed by bending of the steel beams at mid-span, though the straps over the supports did not fail. These riveted straps were somewhat larger in cross-section than the welded straps in Test No. 2.

The load on Test Nos. 1 and 2 is shown in Figure 6. This load here illustrated was 500 lb. per sq. ft. on the center panel and 212½ lb. per sq. ft. on the end panels.

The panels were unequally loaded because of the difficulty of placing sufficient live load on all panels. An analysis of the loading at which failure took place in Test No. 2 indicates that 369 lb. per sq. ft. on all spans would have produced the same negative moment over the interior supports, and 1,275 lb. per sq. ft. on all spans would have produced the same positive moment at the middle of the center span.

Conclusions

It is quite apparent, from a study of the complete test data available, that the aerocrete and the steel beams worked together as would be expected from this composite type of construction. The steel floor beams are, of course, the most important structural element in this construction. The aerocrete filling made an excellent arch to support both the uniform and concentrated loads, it braced the floor beams perfectly and materially reduced the stresses in the steel. Deflections were, in general, from one-third to one-half of the deflections of the bare steel beams under equal applied loads.

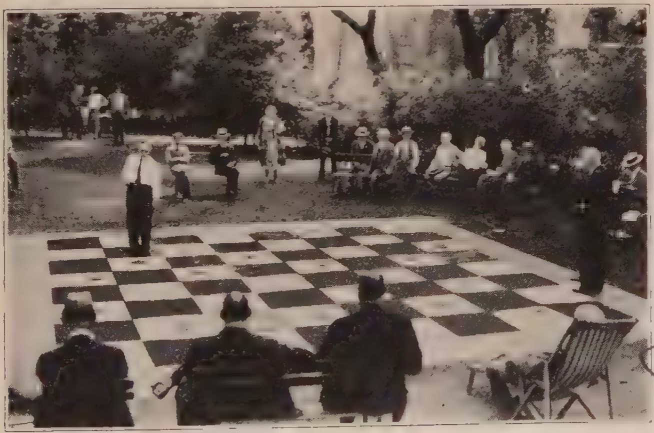
The test also proves that it is feasible to develop continuity in the steel floor beams of adjacent panels.

Old Timers Play on Giant Outdoor Concrete Checkerboard

Equipment Similar to That in Shuffleboard—Expenditure Considered a Good Investment in Health

By **NORMAN BEGGS**
Portland Cement Association, Chicago, Ill.

The Borrowed Time Club of Oak Park, Illinois, comprised of members ranging in age from 70 to 100 years, now has a place to play its favorite game of checkers in Scoville Park in the center of the largest village in the world. The idea of building the outdoor checkerboard court originated with Major Otto McFeeley, editor of *Oak Leaves*, a local paper, and Mr. Pearce, president of the Oak Park Borrowed Time Club.



Playing first game on Oak Park's outdoor concrete checkerboard

The monster concrete checkerboard is 20 by 20 ft., 5 in. thick, and the squares are red and white, 2 ft. in each dimension. There is a 2-ft. blue margin around the exterior on which the players may walk. It was built through the co-operation of Gustav A. Lindberg, superintendent of the park district of Oak Park. The checkers proper are made of basswood, approximately 12 in. in diameter and 4 in. thick. These discs are pushed around with cues similar to the equipment used in a game of shuffleboard, except that the discs are moved slowly. It is planned to place concrete seats around this checkerboard, which is located on sloping ground, so that the game may be easily watched by a number of fans.

From the interest shown in the outdoor checker game, the Village Park Board feels that the small investment required to build this concrete board is well repaid in the health of the old timers.

Louisiana Contractor Hangs Up New Paving Record

Places 982½ Cu. Yd. in 2,653 Lin. Ft.—Mixing Time One Minute—Believed to Be World's Record

On April 27, Glassell-Cochran, Inc., of Shreveport, Louisiana, set a paving record for the state by laying 2,004 lin. ft. of 18-ft. 8-6-8 concrete pavement in a single day. On May 18 they broke this record by laying 2,653 lin. ft.

The records were made on the Bastrop-Monroe highway, Louisiana Highway Commission project 4,300. The mixer was a new 1931 27-E Multi-Foote, and all other equipment was new. The mixing time was 1 min., after all materials were in the drum, the batch meter being set for 1 min. and 3 sec., the additional 3 sec. being the time required for the last of the materials to slide from the skip after the batch meter is stripped. Materials were hauled in single-batch Ford, Chevrolet and International trucks.

Work began at 2:54 a.m. and continued until 8:54 p.m., a total of 18 hrs., and there was a delay of 30 min., making the actual running time 17 hrs. and 30 min. In that time they handled 617 tons of sand, 678 tons of stone, 582 tons of gravel and 4,992 sacks of cement, producing 982½ cu. yd. of concrete. The mixer averaged 47½ batches per hour, or 151½ lin. ft. per hour.

This record is only about 17 ft. under the world's record made several years ago in southern Illinois by Wm. Meneely, when he laid 2,670 ft. in a single day's run. Meneely was using a 32-E mixer and was laying the standard Illinois 9-6-9 pavement 18 ft. wide, requiring 1,858 cu. yd. of concrete per mile, while the Louisiana section requires 1,956 cu. yd. per mile.

Based on cubic yards mixed, which is the real measure of production, the Louisiana contractor produced the most concrete and should therefore be accorded the world's record.

Edward J. Mehren Elected President of P. C. A.

Edward J. Mehren, for many years connected with the McGraw-Hill Publishing Co. in various editorial capacities, and more recently as vice-president in charge of that company's activities in the middle west, has been elected full-time president of the Portland Cement Association.

Mr. Mehren will be in active charge of the association's affairs, with headquarters at the general office at 33 W. Grand Ave., Chicago.

Sledge Hammers and Concrete Flags

Contractors' Experiences in Building Various Types of Flagstone Pavements—How Flags Are Precast

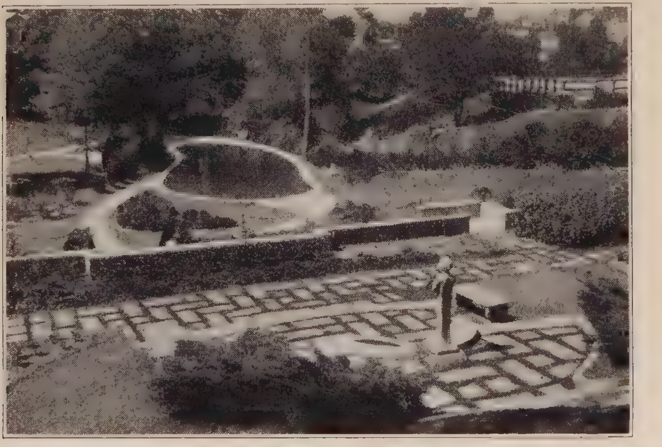
By E. GRANT LANTZ

In meeting the current demand for flagstone walks and driveways of unique, attractive design, concrete contractors throughout the country have developed simple construction methods which enable them to produce colored flags economically and, in some cases, to utilize broken pieces of concrete. It is believed that the experiences of some of these men will interest other contractors.

When the question of colored concrete flagstones came up at a recent contractors' meeting at Houston, Texas, one man's curiosity got the better of him. He stood up and said, "Mr. Holtz, how do you get all those different shapes in your flagstones?"

How Precast Flagging Is Made

Mr. Holtz explained that he made up slabs of colored concrete 2 in. thick and about 3 by 4 ft. in size and gave them the proper moist curing in racks. When a flagstone job comes up, he takes slabs of the required colors and breaks them into suitable sizes with a sledge. These irregular pieces of many colors are then fitted together on a plastic concrete base and white cement mortar grouted in between the pieces.



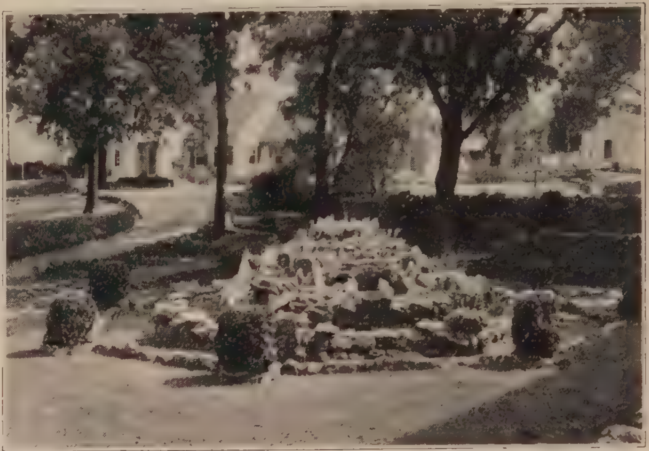
An example of the concrete contracting work of R. O. Marks, Shreveport, La.

R. O. Marks, a concrete contractor of Shreveport, La., was initiated into the flagstone business by a wealthy home owner who had imported large stone slabs from Italy for use in his garden. Mr. Marks was careful to handle each piece carefully and fit them closely in much the same fashion as a sidewalk.

James M. Smitherman, the owner, was horrified. He ordered the beautiful slabs taken up and broken. Under the blows of a heavy sledge the regular lines of the slabs became irregular flagging of great beauty. The owner was pleased. The walk to the street past the concrete fountain was more or less formal but the paths through the gardens were made more natural by the use of the flagstones. Mr. Marks' conversion was complete and his next garden job, in co-operation with a landscape architect, which is illustrated, shows the extensive uses of precast flagging. The surface of the flags was brushed to expose the pea gravel aggregate and produce a natural color. In the background on the left is a shallow pool for fish and semi-aquatic plants. On the right is the bowl-shaped swimming pool with the concrete laid directly on the ground without the use of form work.

A Use for Broken Concrete

Richard Clark, of Dallas, Texas, conceived an attractive use for the concrete sub-base of the street which was being removed from in front of his home. The contractor was more than pleased to pile the concrete on Mr. Clark's lot rather than make a long haul to a dumping ground. For all the retaining walls and fountain, the chunks of concrete were laid up without mortar, there being enough material so that they could be made several feet thick. The beauty of this simple garden should give many contractors an idea for selling broken concrete for uses around homes instead of wasting it in a dump.



This Dallas rock garden and retaining walls in right background are built with broken concrete

Ottie Lawhorn, of Dallas, contracts with local firms handling marble and other stones for interior finishes of buildings to take their broken material. He uses this material in decorating his concrete work. The porch floor of his home is finished with this broken stone set in mortar, like tile.

The increasing desire for beautiful grounds around the home opens a new field for concrete contractors. Landscape architects are quick to patronize the contractor who has the vision to interpret their designs in quality concrete. In refuse materials and irregular masses of concrete produced under the sledge, contractors have a decided opportunity to widen the scope of their activity.

Griffith Short-Cuts in Design

This month's "Short-Cut," by Prof. James R. Griffith, will be followed by the fifth and final installment of this series in the October issue.

The October "Short-Cut" will supply designers with a convenient chart for figuring earth pressure against foundation walls, and the text will discuss the need for attention to this factor.

Rapid Freezing and Thawing Tests for Concrete and Aggregates

Four Cycles in Day With Commercial Refrigerating Equipment—Obtain Consistent Results With Procedure Followed—Measuring Extent of Damage

By C. H. SCHOLER
Professor of Applied Mechanics, Kansas State Agricultural College,
Manhattan, Kansas

LABORATORY investigations of the durability of concrete by freezing and thawing were started in 1926 at Kansas State Agricultural College, with the use of ice and salt as a refrigerating medium. This method was slow, permitting only one cycle of freezing and thawing per day. Since then, two refrigerating machines have been installed and are giving very satisfactory service. Both are Frigidaire units, the first a small ice cream storage unit, and the second a similar unit of the largest size built by this company. Both units operate continuously, the automatic feature having been eliminated. The lowest temperature reached has been —42 deg. F.; the normal operating temperature being —20 to 30 deg. F.

A description of the large unit only is given, as the smaller differs only in size and convenience. This unit consists of a compressor with a 1-hp. motor. The box is cooled with three coils. Alcohol is used around the coils. The box opens at the top and is divided into four compartments, each 10 by 24 by 24 in., and is insulated with 6 in. of cork on sides, bottom and top. Temperatures are measured with resistance thermometers.

The Testing Procedure

In use the refrigerating chambers are kept partially filled with alcohol and test specimens are placed in close fitting metal containers which are then immersed in the alcohol. This gives very rapid and very uniform cooling. Before this was done it was observed that if a chamber was filled with specimens that the outside specimens were frozen very rapidly and those on the inside required several hours more time. Filling the space between the specimens and the container with water still further increased the rate of temperature change and insured constant conditions during test. The temperatures inside of the specimens were measured with a resistance thermometer embedded in the concrete. The same arrangement was used on the thawing cycle. All thawing has been done in tap water at from 55 to 65 deg. F.

Get Four Cycles Per Day

In normal operation we get four cycles of freezing and thawing per day. The specimens can be removed the first thing in the morning, thawed one-half hour, placed in refrigerator and frozen for 2½ hours, thawed for one-half hour, and placed back in the refrigerator before noon. Two similar cycles can be secured in the afternoon and all frozen over night.

If the machine is loaded to capacity, however, the chambers are warmed up so much that only three cycles can be obtained in a day.

In any testing operation of this kind it is highly important that, in so far as possible, all the conditions of test are kept constant. This method of exposure insures very nearly constant conditions.

In testing aggregate we place the stone or gravel in shallow rectangular pans, which may be nested together and placed in larger containers, and these immersed in the alcohol of the freezing chamber. Each sample is kept separate and water about ½ in. deep is placed in each pan.

Highly Satisfactory Results

The results obtained by this method of testing have been highly satisfactory. The test is very discriminating. Poor concrete has been completely disintegrated in 20 cycles and some good samples have been scarcely damaged at 1,500 cycles. Unsound aggregate can readily be detected either as aggregate or in concrete. Consistent results are obtained on successive tests of the same material.

Measuring Extent of Damage

The chief difficulty is in finding a suitable unit in which the relative disintegration or deterioration may be measured or expressed. This is really a very difficult problem to which considerable attention has been given. The first method was a visual inspection and handling with the hands or tapping lightly with a hammer, a method in which the personal equation is very large, and admitted by all to be unsatisfactory. A method in which the relative loss in strength is determined has been used successfully, but it has many drawbacks. This method requires a very large number of specimens and consequently limits the amount of work it is possible to carry on.

It has been suggested that the extent of damage might be determined by placing the test specimens in some type of tumbler after a series of freezing and thawing cycles and determining the loss in weight after a certain number of revolutions. This method has not been tried but is being seriously considered. For certain types of disintegration produced by cherty limestone and gravel it will be of little value, as for these materials the first indication of failure is a breaking down of the entire mass. Where the failure is due to the breaking up of the cement paste the method would seem to have some real possibilities.

From paper on "Durability of Concrete," in 1931 Proceedings of Highway Research Board, Washington, D. C.

Standardized Metal Unit Forms in Floor Slab Construction

Build Floor Slabs with Form Units Used on Foundation Walls—Bar Joist Supports Leave Clear Working Space Below—Assembly of Standard Units

By B. E. WILTSCHECK
Superintendent for Wm. M. Christensen Construction Co., Inc.

Many contractors think of metal unit forms in connection with the construction of concrete walls of different types, from basements to retaining walls or bridge abutments. Concrete bridges, including abutments, girders, beams, slabs and balustrades, have, in many instances, been built with metal unit forms. Consequently, the use of metal unit forms for so relatively simple a job as laying a floor slab is not in the least extraordinary. This statement is made to indicate that Mr. Wiltscheck is not describing a new method in this article, but rather a simplified way of building forms for a specific piece of concrete floor construction.—The Editors.

IN the first two articles of this series the writer described the form units, their accessory clamps and aligners, and their erection or assembly into forms required on the Morgandale High School project. The forms described were for basement walls and were, of course, erected with liners, both horizontal and vertical. He will describe here another use for metal unit forms and a simplified method of erecting forms for concrete floor slabs.

Repeated Use Decreases Cost

If our use of these form units had been confined only to the foundation walls, our profit from their use would have been far less than our investment in them suggests. In other words, our investment in these forms suggests, if it does not economically require, that we get all the use out of them that we can. And, of course, the more often we use them the more we are justified in depreciating our investment in them at the end of the year. So,

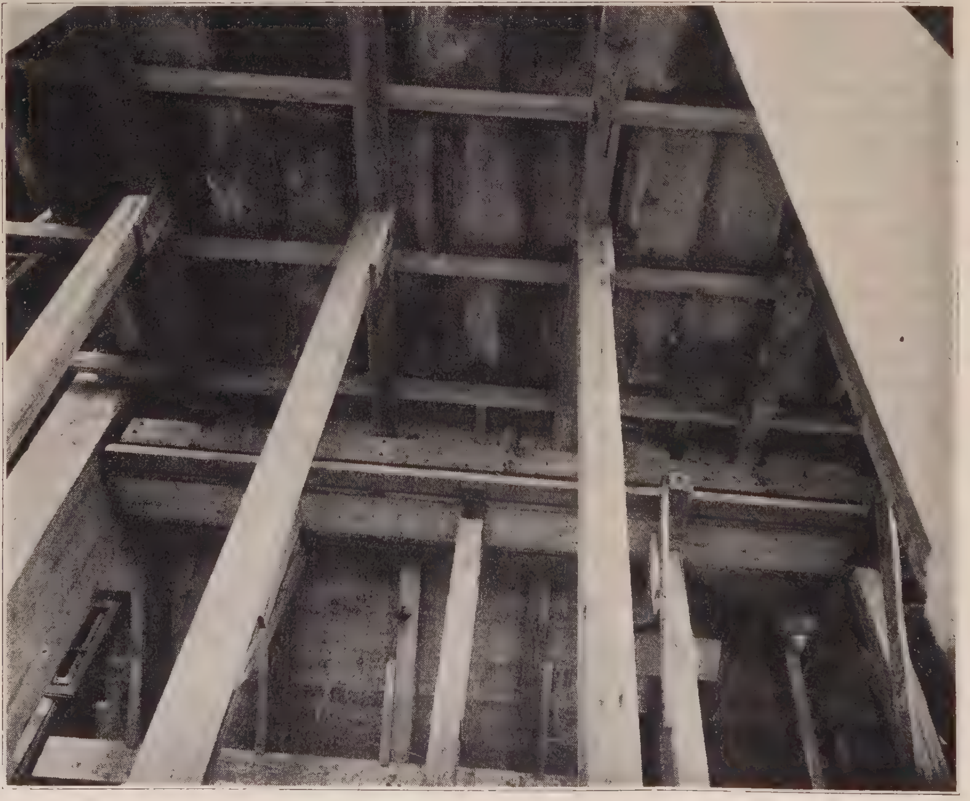


Figure 8. Metal form units in position for stair landing slab, supported by posts and soffits. View looking upward

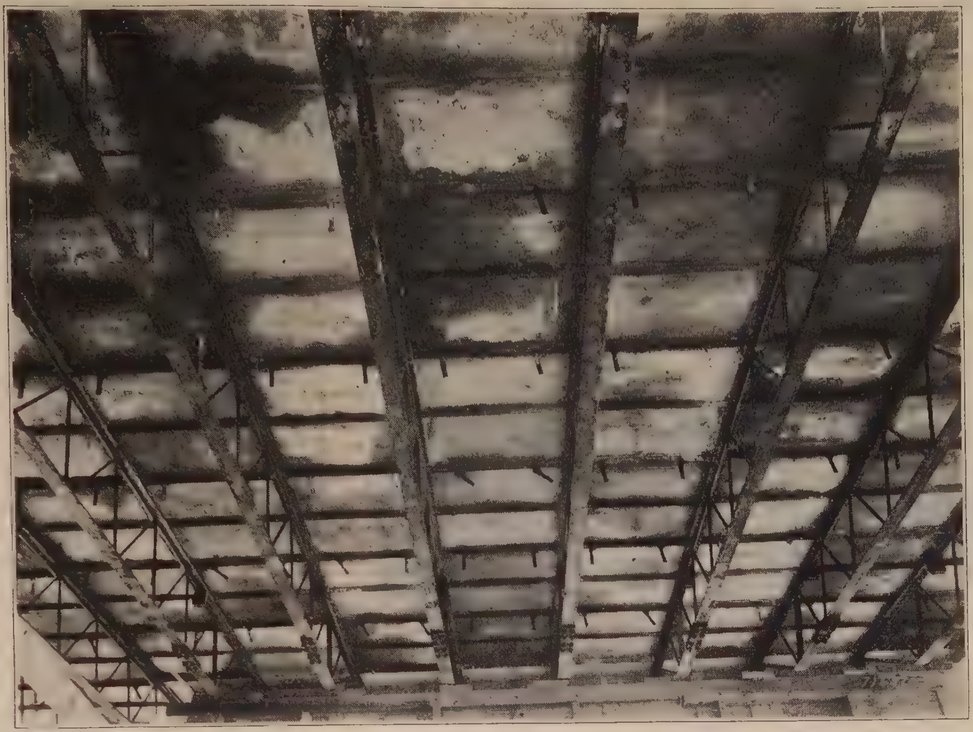


Figure 9. View from below, showing metal forms for upper floor slab supported on steel joists

while the use of our metal unit forms on the foundation walls of the Morgandale project alone was justified from the viewpoint of what they cost us to assemble them, take them down, haul and store them, we add a proportionate profit by again using them for concrete floor slab forms on the upper floors.

We inventory these metal forms as a part of our permanent contractors' equipment, so our aim is to make their active life as long as possible and at the same time to use each unit as often as possible.

Metal Forms for Floor and Stair Landing Slabs

On the Morgandale High School project we used our metal forms for the first floor slab above the boiler room, for the stair landing slabs and for the concrete slab part of the upper floor.

Figure 8 is a view looking upward and shows the forms laid for one of the stair landing slabs. Posts of 4 by 4-in. timber, 4 by 4-in. jacks and 2 by 6-in. soffits were used. Posts were set on 48-in. centers and the 2-by-6 soffits on 24-in. centers to support the free sides of the form units.

From the two previous articles of this series it will be remembered that these units are 24 by 24 in. in size, and that one side of each unit is clamped to the side of the next unit; but that two sides of each unit have no attached clamps and are regularly aligned and fastened together either with cut iron spikes in corresponding holes in the stiffening side angles, or with loose clamps of the same type as those clamping the opposite sides of the units.

How Metal Units Were Assembled as Floor Forms

Form units were laid to center on the 2 by 6-in. soffits, one by one, and clamped to the plate previously laid, on the side at right angles to the soffits, until one full length form panel was assembled. Then we clamped together enough plates to make up panels the full length of the slab and progressively laid them face up on the soffits, wiring the panels together at intervals on the free sides (which, of course, lay on the soffits). The panels laid there flatly, close together, joints tight enough to prevent excessive leaking, giving us a very fine, dense slab. Reinforcing steel was cradled on the form surface, of course, just as it would be on a wood form.

The skeletonized shoring shown in Figure 8 is all that is ever necessary in building metal unit forms for floor slabs. Heavier floors merely require heavier soffits, jacks and posts.

Posts were adjusted finally with jacks, as usual, and when the plates were removed the jacks were lowered, releasing the soffits. When the soffits were removed the plates were taken down one by one, and the posts and jacks again raised to support the slab temporarily.

Form Panels for Floor and Roof Slabs Supported on Steel Joists

In erecting metal forms for the upper floor slab an entirely different method was used. We wanted enough open floor space for various work, and we could not have it with the regular method of shoring with posts. So we used adjustable steel joints supported at either end on the shoring for the double girder forms. This method of supporting the upper floor slab forms is shown in Figure 9, a view taken from below.[1]

This method of erecting forms for a roof or floor slab is entirely practical, convenient and fast. We leased the adjustable joists from a local distributor, who placed them on the shoring on 24-in. centers, ready for the form panels, and removed them at the proper time. While the total cost of using adjustable joists was about the same as for erecting shoring with our own men, the use of the open floor space throughout our upper floor and roof slab operations was of considerable value to us.

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[1] A similar method of supporting floor slab forms was employed in the construction of the Merchandise Mart, in Chicago, as described in the October (1929) issue of CONCRETE, pages 13-16.

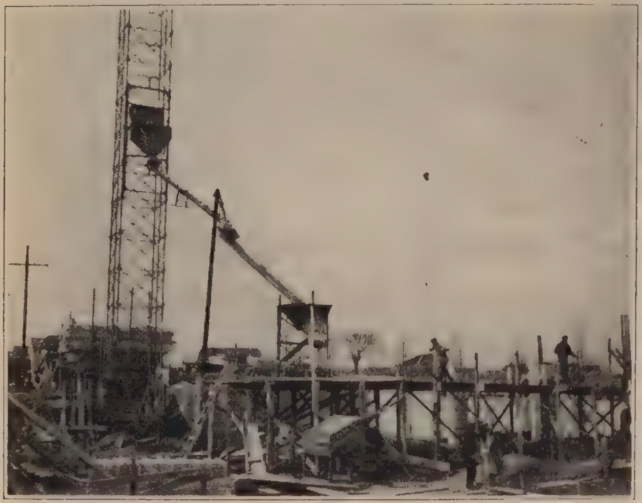


Figure 10. The concreting plant on the Morgandale High School contract

Assembling Form Units on Steel Joist Supports

The reproduced photograph (Figure 9) showing the form units laid in clamped-together panels on the steel joists gives a fairly good idea of the simple work of erecting these slab forms. When the joists were ready, several plates were clamped together into an easily handled panel and laid face up, centered on the joists. It was not necessary to wire more than every other two panels together on the joists. They laid tightly enough together so that there was very little loss of mortar. The resulting slab was very dense and fine in appearance.

Removing Joists and Form Units

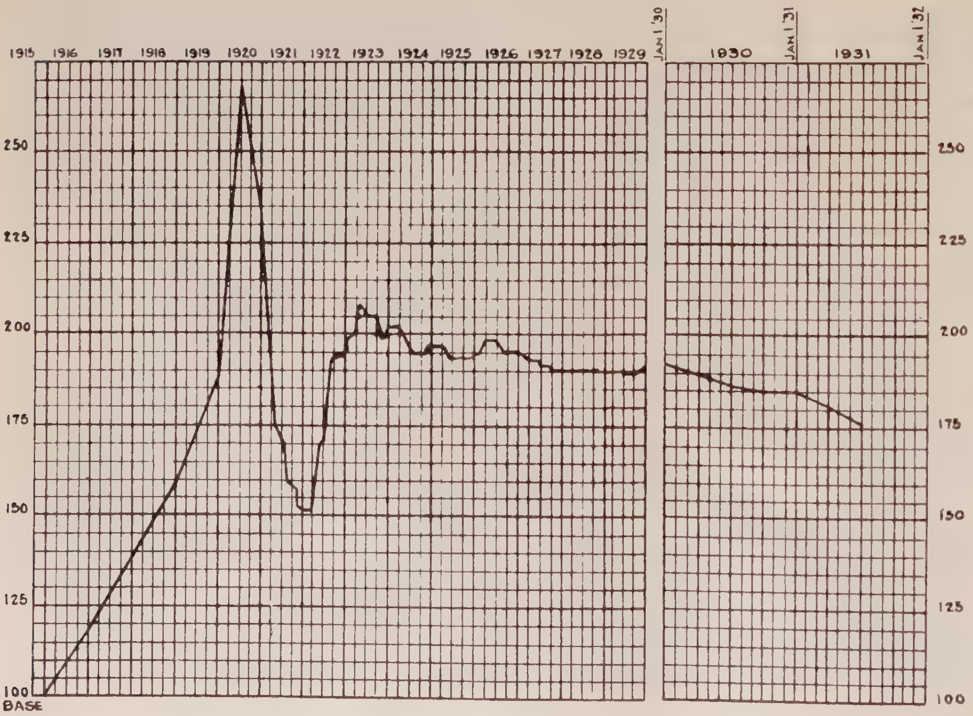
In setting the joist ends on the girder forms, they were placed on blocks, so that when the joists were to be removed, these blocks were knocked free, letting the joists down to clear. Removing the plates was merely a matter of knocking their clamps loose and lowering them one by one, stacking them as they came down.

Acknowledgments

As stated in the second article of this series, the contractor on the Morgandale High School building was the Wm. M. Christensen Construction Company, Inc., of Racine, Wis., while the writer was superintendent of construction. The metal unit forms employed on this work were manufactured by the Metal Forms Corporation, of Milwaukee.

Abertham Index of Cost of Building

(Published in the issues of February, May, August and November)



Building costs continue to decline, as indicated by the Aberthaw Index of Cost of Building which, for the quarter ending June 30, shows a drop of 5 points to 176. This index value represents a cost of $1.85 per sq. ft. of floor area for the 7-story reinforced concrete industrial building used as the basis for the estimate. This decline is due to further reductions in prices of building materials, principally cement, lumber, and steel, and to marked increase in labor efficiency, which is now sufficiently evident to warrant definite valuation in the index.

In the purchase of materials and placing of sub-contracts opportunities for advantageous purchases occur which are not evident under normal conditions.

Use of Color in Troweled Surfaces

Committee 408 of the A. C. I. Develops Practice—Mixing Cement and Pigments in Drum—Sizes of Aggregates—Mixing, Placing, Troweling and Curing

THE principal classes of color materials are: 1. Pigment admixtures; 2. Selected aggregates; 3. Chemical stains; and 4. Water and oil vehicle paints.

Of the four classes of color work, there is most urgent demand for information on the use of pigment admixtures in troweled concrete surfaces, which is the basis of the Committee's first report.

General Requirements for Pigments

Only inorganic pigments, as limited in this section, should be used in troweled concrete surfaces. Synthetic and natural mineral pigments are satisfactory if they meet the following requirements:

1. Insoluble in water.
2. Free from soluble salts.
3. Free from acids.
4. Fast to intense sunlight.
5. Fast to heat up to 300 deg. F.
6. Not to exceed 2 per cent by weight of free moisture.
7. Fast to alkali and weak acids.
8. Free from calcium sulphate in excess of 15 per cent by weight.
9. At least 90 per cent of synthetic pigments pass a 325-mesh sieve and at least 90 per cent of natural pigments pass a 200-mesh sieve.

Selection of Pigments

Red—Use either synthetic or natural oxides of iron.

Yellow—Use synthetic yellow oxide of iron.

Buff—Use either natural or synthetic yellow oxides of iron.

Brown—Use synthetic or natural brown oxides of iron.

Black, Gray—Use synthetic black iron oxide.

Green—Use only synthetic chromium oxide; Cr_2O_3, at least 98 per cent pure.

Blue—Use synthetic cobalt blue at least 98 per cent pure and free from sulphates.

Color Value of Pigments

No table of definite color values can be given for pigments in concrete. It is necessary for the user to prepare sample panels of convenient size and combine the pigment in various accurately weighed amounts with a definitely known amount of cement, aggregates and water, such as he will use on the job. All proportions must be accurately made and the whole mass thoroughly mixed, placed and finished exactly in the way it will be done on the job. The panels should then be cured in the same manner that the job will be cured and then allowed to dry. The surface of the panel should then be wiped off with a mixture of one part paraffin oil and one part of benzine or similar vehicle and allowed to dry. From these sample panels, the color values possible with different materials and combinations can be determined and then, by reference to the data covering the method of producing the original panels, the color can be duplicated within very narrow limits.

Blending Pigments

Considerable skill and adequate equipment are required to blend successfully two or more pigments. Contractors and other users of pigments with a good "eye for color" can enlarge the range of colors available by blending or mixing the primary colors. It is recommended that blended colors be purchased from reputable color manufacturers unless the user is sufficiently experienced and equipped to blend his own pigments. An accurate record of the exact amounts of colors used, weighed to the nearest ounce, for one-sack batches is absolutely necessary to get satisfactory results with blended colors.

Proportioning Pigments

All the materials entering into the batch must be carefully weighed. The quantities of pigment and other ingredients to be used are determined from the sample panels. Uniform results require that every batch be proportioned, mixed, placed, finished and cured exactly like every other.

Mixing Pigments

Pigments must be thoroughly mixed with the cement and with the cement and aggregate to get uniform work.

The color mixer, which is a tight, revolving metal drum with stationary paddles or blades, or a stationary drum with revolving paddles or blades of sufficient capacity to hold one or more sacks of cement with the pigment, is the best method for mixing pigments. The cement and pigment are accurately weighed and placed in the mixer and mixed for not less than ten minutes. When the batch is mixed it is sacked and kept dry until it is used.

In the absence of a color mixer on important work, it is recommended that factory-prepared colored cement be purchased from a reputable manufacturer.

Selection of Aggregates

For all severe wear and exposure, the aggregates should be composed of fine and coarse particles graded as follows:

Fine aggregate—All passing a ¼-in. screen, not more than 10 per cent passing a 50-mesh screen and not more than 3 per cent passing a 100-mesh screen.

Coarse aggregate—All passing a ⅜-in. screen and all retained on a ⅛-in. screen.

Aggregates should be hard, durable sand, pebbles or

Abstracted from report presented by W. D. M. Allan, chairman of Committee 408 of the American Concrete Institute.

crushed materials free from dust, loam, clay or vegetable matter and contain no flat, elongated or flaky particles.

Proportions of Cement and Aggregate

For severe wear and exposure, the proportions should be approximately one sack of cement, one cu. ft. of fine aggregate and two cu. ft. of coarse aggregate.

For light wear and exposure, the proportions should be approximately one sack of cement and two cu. ft. of fine aggregate.

The proportions of aggregate may be varied to correct for workability and consistency.

Mixing Water

The total amount of mixing water to be added with each sack of cement should not exceed 5 gal., including the free moisture in the aggregate. In adjusting the proportions of aggregate, correction for free moisture should be made.

Consistency

Colored concrete for troweled surfaces should be placed as stiff as possible. The slump in no case should exceed 4 to 5 in. Very little, if any, water should appear on the surface when it is screeded or straight-edged.

Mixing

Colored concrete, especially for two-course monolithic and regular two-course work, should be mixed not less than two minutes after all the materials, including the water, are placed in the mixer if the cement and pigment have been thoroughly mixed before being placed in the mixer. At least five minutes longer will be required for mixing if the pigment has not previously been mixed with the cement.

Placing

Two-course monolithic and regular two-course work should be placed on bases that are clean and free from water. In two-course monolithic work, the base should stand until all the surface water has either evaporated or has been broomed or screeded off or removed in some other manner. All laitance or scum shall be removed before the colored concrete is placed.

The colored concrete should be deposited in small batches close together and screeded or straight-edged to grade. Special care shall be taken when straight-edging to fill up and prevent low places in the topping. The surface should then be wood floated and allowed to stiffen before the steel trowel is used. Areas of colored topping should be placed small enough so that by the time of finishing all of the topping will have stiffened to the same degree.

Troweling

Steel troweling should be delayed as long as possible and still be able to finish to a smooth compact surface. Troweling should be reduced to a minimum and the final strokes be made all in one direction. Sprinkling the surface with water to aid in troweling should not be permitted.

Curing

All colored concrete surfaces should be damp cured for not less than seven days. Where subjected to severe wear or exposure the damp curing should continue for not less than 10 days. The surface at no time during these periods should show any tendency toward drying. Ponding, completely covering with damp sand or with approved grades of heavy waterproofed paper or fabric should be required.

U. S. Civil Service Examinations for Engineering Positions

The United States Civil Service Commission announces open competitive examinations for the positions of associate engineer and assistant engineer.

Applications for the positions of associate engineer (optional branches—aerial navigation, aeronautical, construction, heating and ventilating, and telephone and telegraph engineering) and assistant engineer (optional branches—heating and ventilating, and construction engineering) must be on file with the United States Civil Service Commission, Washington, D. C., not later than August 21, 1931.

Besser Acquires Consolidated Interest by Stock Purchase

The following announcement concerning two leading manufacturers of concrete products machinery, coming from the officers of the two companies, is of interest:

"The Besser Manufacturing Company of Alpena, Mich., recently acquired by purchase from private interests, a substantial block of the capital stock of Consolidated Concrete Machinery Corporation, Adrian, Mich. This inter-ownership of stock in two of the leading companies manufacturing concrete products equipment is in no sense a merger of the concerns.

"While the new affiliation will bring benefits of co-operation that will prove of advantage to the industry as a whole, it will not result in any unusual changes in the line of equipment, the personnel, or sales organization of either company."

Third Article on Movable Forms in September Issue

The third article on movable forms, by Richard T. McKay, will appear in the September issue of "Concrete."

The first of these articles, published in the April issue, described the layout and construction of movable forms for circular concrete structures such as storage bins. The second article, in the May issue, described further details and the actual operation of the forms.

In the final article, in the September issue, the removal of this type of concrete form work will be described and illustrated.

Short-Cuts in Structural Design

Chart Giving Area Moment Provides Quick Solution for Design of Column Footing when Column Load, Size of Column and Size of Footing Are Known

IV—Bending in Square Column Footings

By JAMES R. GRIFFITH
Professor of Structural Engineering, Oregon State Agricultural College

THE critical section for bending in a square column footing is usually taken at the face of the column. The moment is found from the load on the trapezoid (*abcd*) Figure 1. The magnitude of this moment is obtained by taking the product of the resultant uplift pressure on the trapezoid, and the area moment of the trapezoid about section (*ad*). The chart has been designed to give the area moment at the intersection of the given values of (*P*) and (*D*).

Illustrative Example

In order to illustrate the use of the chart and compare its accuracy, I assume the following conditions:

A 24-in. square column supporting a total load of 350,000 lb. rests on a 10-ft. square footing 30 in. thick. The bending moment is independent of the footing thickness. But since this is sometimes hard for the beginner to see, I have assumed a thickness.

Column load = 350,000 lb.
Footing weight = 37,500 lb.

Total load on soil = 387,500 lb.

Unit soil pressure under footing =

$$\frac{387{,}500}{10 \times 10} = 3{,}875 \text{ lb. per sq. ft.}$$

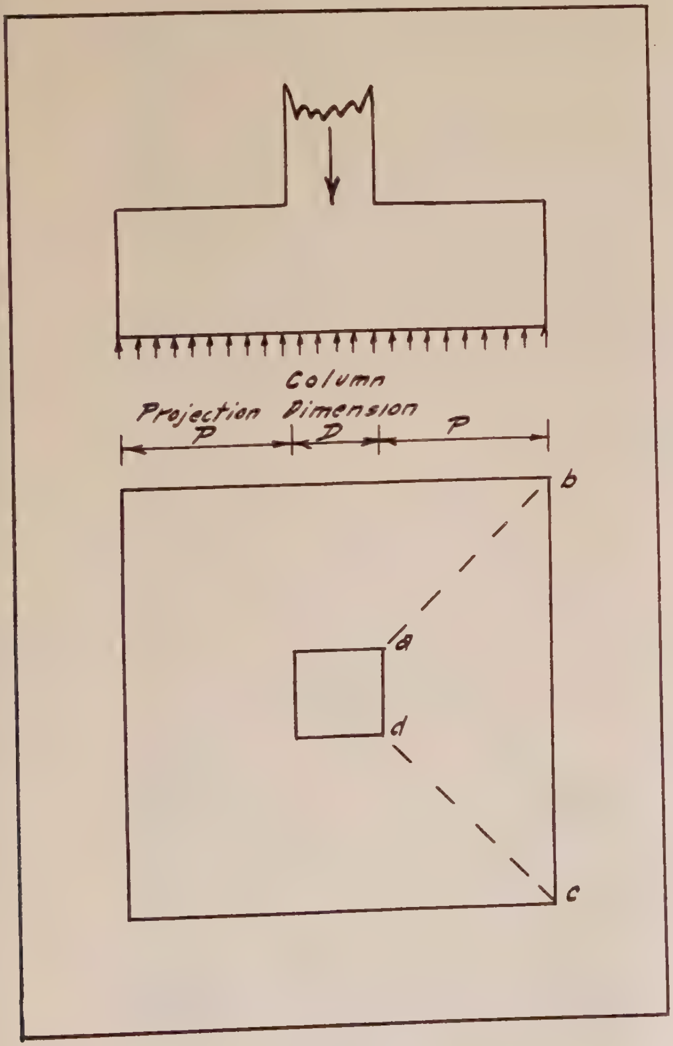


Figure 1.

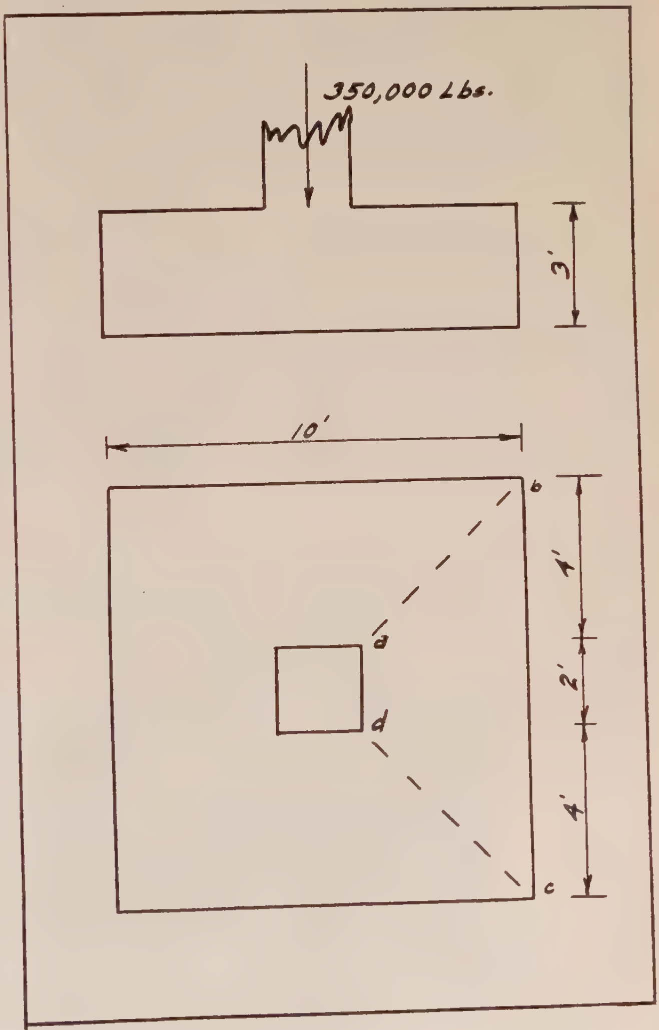
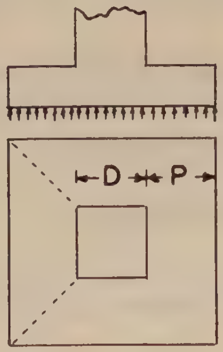
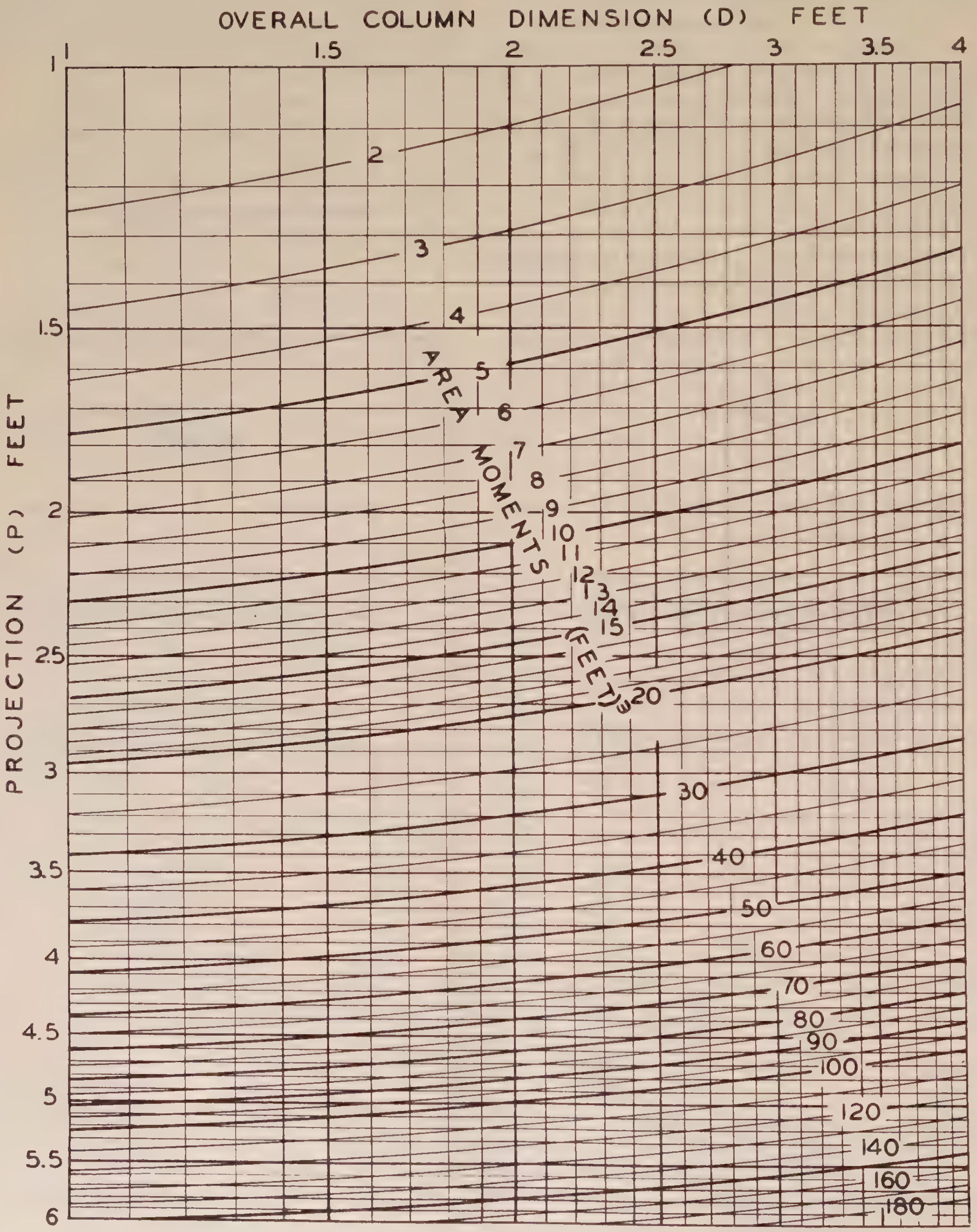


Figure 2.



Bending in Square Column Footings

Multiply Area-Moment by Resultant Uplift (Lb. Sq. Ft.)
to Obtain Bending Moment (Ft. Lbs.)



The resultant load on the footing is the soil pressure less the weight of the footing.

Soil pressure = 3,875 lb. per sq. ft.
Footing weight = 375 lb. per sq. ft.

Resultant load = 3,500 lb. per sq. ft.

This same resultant load may be obtained directly by dividing the column load by the footing area.

$$\text{Resultant load} = \frac{350{,}000}{10 \times 10} = 3{,}500 \text{ lb. per sq. ft.}$$

From Figure 2, it is seen that—

Column dimension, $D = 2.0$ ft.
Footing projection, $P = 4.0$ ft.

At the intersection of these two values on the chart I find a value of the area moment slightly less than 55, which I shall call—

Area moment = 54.5 ft.^{3}

I then have—

Bending moment = Area moment × resultant load
= 54.5 × 3,500 = 191,000 ft.-lb.

In order to compare the accuracy of the chart, I have made the following check solution:

The trapezoid can be divided into two triangles and one rectangle, Figure 3. The total pressure on the rectangle is considered as concentrated at a distance out equal to $P/2$ from section (*ad*). The total pressure on the triangles is taken as acting at a point 0.6 P out from section (*ad*), as recommended by the Joint Committee Specifications.

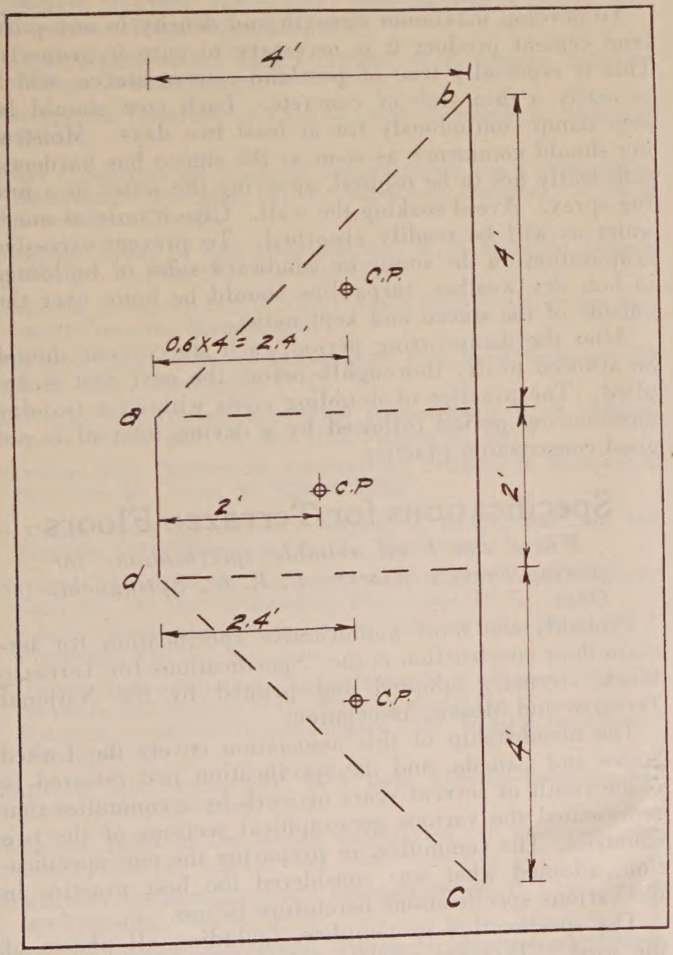


Figure 3.

Moments:

On rectangle, 3,500 (2 × 4) 2 = 56,000
On triangles, 3,500 (4 × 4) 2.4 = 134,400

Total moment = 190,400 ft.-lb.

This is a reasonable check on the result obtained by the chart.

International Testing Congress Convenes in Switzerland

First International Congress of New International Association for Testing Materials to Discuss Cement and Concrete

The first International Congress of the New International Association for the Testing of Materials will be held this year from September 6 to 12 in Zurich, Switzerland, in the buildings of the Swiss Federal Polytechnicum. The association consists of individuals and companies in the various countries. In the United States, the national association through which contacts are established is the American Society for Testing Materials, and many of its members belong to the international body.

The objects of the association are to secure international co-operation, exchange of views and experience in regard to all matters connected with the testing of materials. The chief means of securing this result is the holding of periodical International Congresses at intervals of from three to five years. The work does not involve standardization of materials, which is one of the chief functions of the A. S. T. M.

The technical program includes the following problems in cement and concrete:

1. Portland Cements.
2. Cements with Hydraulic Ingredients, Trass, Pozzolana, Santorin Earth and Blast-Furnace Slag.
3. Aluminous Cement.
4. Concrete, Strength, Elasticity, Compactness.
5. Influence of Chemical Agents on Cement and Concrete.
6. Reinforced Concrete.

Americans will have a prominent part in the program. The two following authors will give papers dealing with concrete and reinforced concrete:

W. A. Slater, research professor of engineering materials, Lehigh University, "Designing Concrete for High Strength, Low Permeability and Low Shrinkage." F. E. Richart, associate professor of mechanics, University of Illinois, "Stresses and Strains in Reinforced Concrete Columns."

Steps are being taken to arrange traveling facilities for all who wish to take part in the congress.

W. H. Fulweiler, the A. S. T. M. representative on the permanent committee which governs the International Association, is chemical engineer of the United Gas Improvement Co., Philadelphia. Further details may be procured from him or C. L. Warwick, secretary-treasurer, American Society for Testing Materials, Philadelphia.

HOW TO DO IT

✦ **Questions and Answers** ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Temperature of Concrete Predicted from Temperature of Materials

We expect during the coming winter to do some experimental work toward predicting the temperature of mixed concrete when the quantity (or weight) and the temperature of the mixing water, the cement and the aggregates are known.

Can you refer us to a reliable formula which may be used as a basis of comparison with actual results obtained by experiment. Assuming the quantities and temperatures given on the attached sheet, and applying the values to such formulas as we have been able to locate, we get estimated temperatures ranging all the way from 41 to 96 deg. F.—D. P. A., Worcester, Mass.

The quantities and temperatures given on the attachment to your letter are as follows:

Weight of water (36 gal.)	300 lb.
Weight of sand and gravel	3,555 lb.
Weight of cement	564 lb.
Temperature of water	200 deg. F.
Temp. of sand and gravel	20 deg. F.
Temperature of cement	60 deg. F.

When these values are applied to a formula in an article by A. C. Irwin, printed on page 24 of the January (1931) issue of CONCRETE, under the heading of "Heated Water Supplies Warmth During Moderately Cold Weather," the computed temperature of the mixed concrete is 69 deg. F.

It is interesting to see that the value obtained by the Irwin formula is almost exactly midway between the highest and lowest values obtained with the various formulas you have tried.

Refinishing Old Stucco Work

In this railroad town a stucco house which has been up about ten years is darkened up with coal smoke. The owner has asked us to clean or recoat the surface. Can you tell me the method of procedure?—B. F. J., Brunswick, Md.

Your problem is well covered in the Plasterer's Manual, published by the Portland Cement Association, from which the paragraphs that follow are taken.

It is comparatively simple to resurface old stucco jobs to renew the finish and change the color or texture, or both. This may be done, provided the old stucco is in a sound condition. If the original stucco is unsound, it will be necessary to remove the old material entirely and apply a new three-coat job. Where old stucco is not readily removable, as is often the case on masonry backing, it will be necessary to cover the old surface with paper and metal reinforcement and then apply the standard three coats.

Old stucco surfaces, when sound, are prepared for refinishing by wetting the entire area and then cleaning it with a solution of 1 part muriatic acid and 6 parts water. After acid-treating, it should be thoroughly washed with water to remove all traces of the acid and any loose particles.

The wall should be allowed to dry thoroughly and then moistened just prior to application of the new coat, to secure uniform suction. On surfaces of coarse or rough texture (as, for example, rough cast work), the new finish may be a single coat applied with the trowel. If the old surface lacks roughness it will be necessary to apply two coats—the first coat being a dash coat to establish bond. After the dash coat has been properly cured, as described below, the finish coat is troweled on.

Portland cement stucco must not be applied directly over lime, gypsum or magnesite stucco. These materials either should be removed entirely or they should be covered first with waterproof paper and metal reinforcement. In either case standard three-coat portland cement stucco should be applied.

To develop maximum strength and density in any portland cement product it is necessary to cure it properly. This is especially true of portland cement stucco, which is really a thin slab of concrete. Each coat should be kept damp continuously for at least two days. Moistening should commence as soon as the stucco has hardened sufficiently not to be injured, applying the water in a fine fog spray. Avoid soaking the wall. Give it only as much water as will be readily absorbed. To prevent excessive evaporation on the sunny or windward sides of buildings in hot, dry weather, tarpaulins should be hung over the outside of the stucco and kept moist.

After the damp-curing period, each stucco coat should be allowed to dry thoroughly before the next coat is applied. The practice of doubling coats without a two-day moist-curing period followed by a drying interval is not good construction practice.

Specifications for Terrazzo Floors

Where can I get reliable specifications for placing terrazzo floors?—E. R. C., Springfield, Ohio.

Probably the most authoritative specification for terrazzo floor construction is the "Specifications for Terrazzo Work" recently adopted and printed by the National Terrazzo and Mosaic Association.

The membership of this association covers the United States and Canada, and the specification just referred to is the result of several years of work by a committee that represented the various geographical sections of the two countries. The committee, in preparing the new specification, adopted what was considered the best practice in the various specifications heretofore in use.

The specification is complete, including all phases of the work. Terrazzo partitions and wainscoting are covered, as well as floors.

Copies of the printed specification can be obtained from the National Terrazzo and Mosaic Association, 815 West St. Paul Ave., Milwaukee, Wis.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 624 Fisher Building, Detroit, Mich.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

Twenty-ninth annual convention and road show, January 9-15, Detroit Airport building, Detroit, Mich.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.

American Standards Association; P. G. Agnew, Secretary, 29 West 39th St., New York City.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Canadian Engineering Standards Association; 178 Queen St., Ottawa, Ontario.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Bldg., Washington, D. C.

National Engineering Inspection Association; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Building, Washington, D. C.

Second annual convention, January 25-26, William Penn Hotel, Pittsburgh, Pa.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.

Sixteenth annual convention, January 27-29, William Penn Hotel, Pittsburgh, Pa.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

National Terrazzo and Mosaic Association; U. F. Durner, Secretary, 815 West St. Paul Ave., Milwaukee, Wis.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

The Concrete Industry —25 YEARS AGO

"CONGRESS has appropriated, . . . the sum of $100,000 for the purpose of making scientific tests on the buildings of the World's Fair at St. Louis," according to the August, 1906, issue of Concrete. "Tests will be undertaken to determine the strength and utility of concrete in various uses, its fire-resisting qualities and the relative quality of different kinds of mixture."

Continuing, "Uniform specifications, based on the unbiased findings of government experts, will result from the investigations at St. Louis. Only good to the industry can result from their work. . . . Slipshod methods of manufacture will be pointed out and the remedy will be suggested. Concrete will receive from official sources the attention which it has had for some time from the public in general. This very interest has resulted in some dangers to the industry, which the reports of the tests should go far to remove."

* * *

IT was 25 years ago that Thomas Edison was widely quoted following a newspaper interview in which he described his ideas on concrete house construction. An item in *Cement Age* for August, 1906, quotes him as saying that "a series of movable, interchangeable molds for cement houses of varying designs, and all the paraphernalia for using it, would be easily within the compass of a corporation or firm with a capital of $100,000. From these molds, and with semi-fluid concrete made with cement and poured into the molds, houses could be built in a few hours, ready to have all the windows, heating pipes . . . put in place.

"Just say for me that I have tried it and know it will work, and that I would do it myself as a business if I had time, which I haven't.

" . . . inside of 10 years you will be living in a cement house."

* * *

A LENGTHY article by the late Richard K. Meade is "Determination of the Specific Gravity of Cements," in which he tells of his experiments to determine the reliability of the various forms of apparatus in common use.

* * *

A PLAN for fire- and burglar-proof vault construction, evolved at Indianapolis is described and sketched. The designer proposes, as the initial step, the erection of a cage around which the concrete is poured. The lattice would be made of $\frac{3}{4}$-in. gas pipe, each pipe having inside a loose steel bar $\frac{1}{2}$ in. in diameter.

If the burglar succeeds in cutting through the concrete and the pipe, "he would meet an insurmountable obstacle in striking the bar, for his saw, on hitting the steel, would come into contact with a movable body upon which no purchase would be possible."

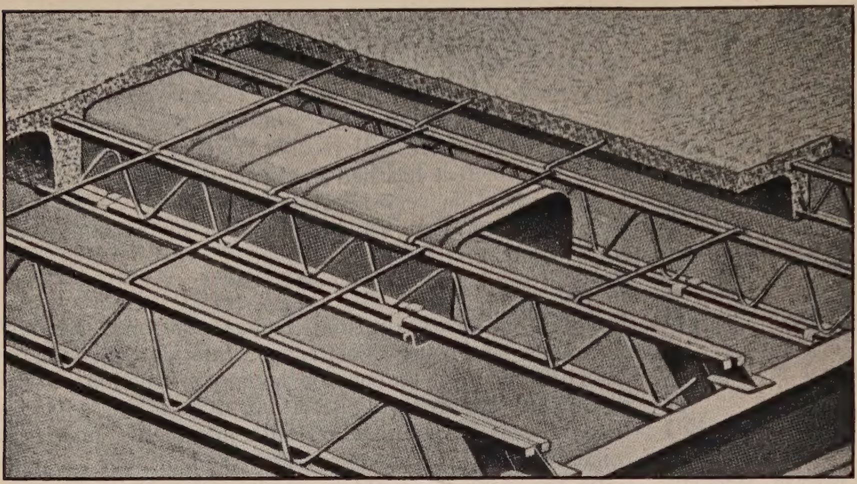
* * *

DETAILS of the cost and manufacture of concrete pipe, in farm use, as prepared by S. M. Woodward of the U. S. Department of Agriculture, and read before the National Association of Cement Users' convention at Milwaukee, Wisconsin, in the summer of 1906, are published in part.

New Equipment and Materials

Features of Sereff Self-Sustaining Reinforcement System

The Sereff system of self-sustaining reinforcement for concrete construction provides a method that completely eliminates



shoring, centering and wiring of reinforcing, it is stated. The fabricated reinforcement units are made to support soffit forms and core forms, without propping from beneath.

The Sereff system is adaptable for ribbed-slab construction employing permament steel core-forms; ribbed-slab construction employing removable steel core-forms, and ribbed-slab construction employing standard terra-cotta tile for cored areas.

All Sereff reinforcing units are made so they will bear on structural I-beams, reinforced concrete beams or masonry walls.

The fabricated units are said to be automatically spaced by temperature bars, placed from above and holding them rigidly in position, without requiring extra time and labor for wiring. The soffit forms, suspended from the units, support the core forms in the correct position for placing concrete. After the concrete has set, soffit forms and removable cores, if used, are removed and are ready immediately for use on other floors.

The Sereff system is a division of the Bellefontaine Bridge & Steel Co., Bellefontaine, Ohio.

Lee Transit Mixer Company Makes Improvements on Unit

New improvements, including several refinements adding to its adaptability and economy of operation, have been made in their Transit Mix body, according to the Lee Transit Mixer Company, Indianapolis, Ind.

The Transit Mix is a 1-yd. unit that may be mounted on any light truck chassis. Its use, in connection with central batcher bins, is said to cut costs at least 25 per cent.

Industrial Literature

Testing Equipment Catalog

Cement and concrete testing machines and equipment are covered in a section of a catalog issued by *Riehle Brothers Testing Machine Co.*, Philadelphia, Pa.

Machines and equipment included are a pipe testing machine, automatic shot compression machine, concrete beam tester, impact machine, and flow table.

Vaso Admixture

Technical information on *Vaso* is given in an 8-page leaflet issued by the *Vaso Manufacturing Company*, Seattle, Wash.

Vaso is a bituminous liquid and the information given on it includes a table of the amounts to be used for centrally-mixed concrete, securing watertight concrete, and suggested uses and quantities of Vaso for concrete construction.

Universal Devices

Two new 4-page folders issued by the *Universal Form Clamp Company*, Chicago, cover form clamps for all types of concrete construction, and band and wire clamps.

Each shows the devices in use in various applications.

Manufacturers' News

Ransome Acquires Interest in Transit Mixers

The Ransome Concrete Machinery Co., Dunellen, N. J., has acquired a controlling interest in *Transit Mixers, Inc.*, San Francisco, Calif., and will hereafter manufacture the latter's unit at its New Jersey plant.

There will be no change in the position or policy of the Ransome Concrete Machinery Co. in the field now occupied by it. The two firms will operate as distinctly separate units, and there is no connection by the Ransome Concrete Machinery Co., by license agreement or otherwise, with any other concern in the truck mixer field, it is stated.

Kanzig District Sales Manager

Charles S. Kanzig has been appointed as district sales manager of the Chicago metropolitan territory by the *Medusa Portland Cement Company*, Cleveland, Ohio.

Mr. Kanzig has been associated with the Manitowoc Portland Cement Co., Manitowoc, Wis., from the time of its inception, and when it became a unit of the Medusa company he became a member of that organization.

Nazco New H.E.S. Cement

The Nazareth Cement Company, Nazareth, Pa., announces that it has entered the high early strength portland cement field with *Nazco*. This, it is stated, is a specially prepared portland cement, containing no admixtures, and guaranteed to conform with all the requirements of the tentative specification of the A.S.T.M.

Nazco is available in full carload lots or mixed carload lots with Nazareth.

Chain Belt Offers Prizes

Inspired by successful efforts in their own factory to reduce costs by the application of modern machinery, the *Chain Belt Company* of Milwaukee has offered prizes for articles describing successful application of chain and belt conveyors and other construction machinery to reduce costs. The period for submission of articles extends from August 1 to September 21 and is open to construction companies, concrete products makers, central mixing plants and other users of material handling equipment.